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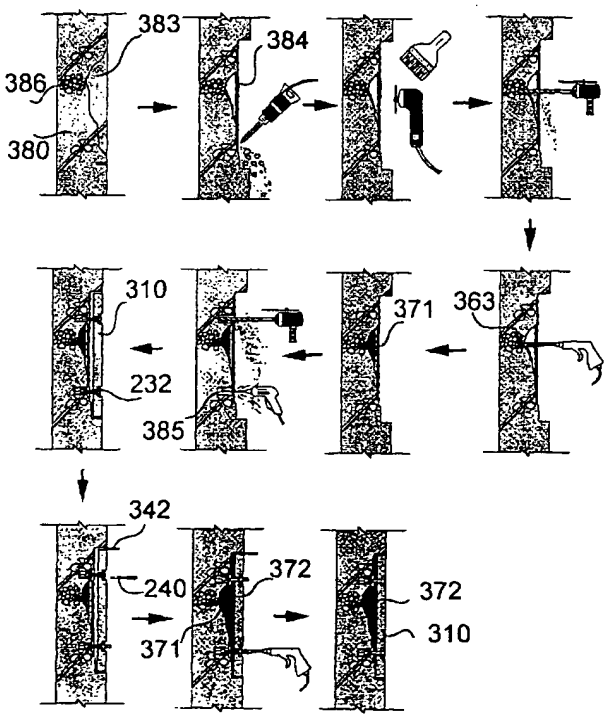
(54) Title: COMPOSITE PANEL FOR REPAIRING, REINFORCING CON'C BODY AND METHOD OF USING THE SAME



(57) Abstract: Disclosed are a panel for repairing and reinforcing a concrete body, a multi-purpose anchor, an anchor for level adjustment and injection a method for repairing and reinforcing the concrete body using the same, which can connect adhesives and anchors at weak parts of the concrete body, which is neutralized, aged, deteriorated, cracked due to water leakage, or segregated, or at parts requiring the repair and reinforcement due to a change in use environment. The composite reinforced panel includes lightweight concrete, high strength concrete or a steel plate and reinforcing means, thereby being effectively prevented from bad environments causing a drop of reinforcing capacity, providing good heatproof and fireproof properties, and maximizing merits of materials used as the reinforcing means. The multi-purpose anchor has a bolt and an injection pipe, fixes the panel to the concrete body effectively, serves as a spacer maintaining a prescribed interval between the panel and the concrete body, and serves to inject filler and discharge the inside air to the outside, thereby improving construction efficiency. The anchor for level adjustment and injection has a male screw and a female screw at an end and an injection pipe of a straw type, thereby improving the construction efficiency when the concrete panel is installed.

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COMPOSITE PANEL FOR REPAIRING, REINFORCING CON'C BODY AND METHOD OF USING THE SAME

Technical Field

The present invention relates to a panel for repairing and reinforcing a concrete body, a multi-purpose anchor, an anchor for level adjustment and injection and a method for repairing and reinforcing the concrete body using the same. More particularly, the present invention relates to a panel for repairing and reinforcing a concrete body, a multi-purpose anchor, an anchor for level adjustment and injection and a method for repairing and reinforcing the concrete body using the same, which can connect adhesives and anchors at weak parts of the concrete body, which is neutralized, aged, deteriorated, cracked due to water leakage, or segregated, or at parts requiring the repair and reinforcement due to a change in use environment.

Background Art

People have generally recognized that a reinforced concrete body is semi-permanent, but the reinforced concrete body is aged and deteriorated due to various causes, such as neutralization, corrosion of reinforced steels, exfoliation of an outer layer due to dryness, contraction and expansion, error in design, false construction, fatigue load, change in use environment, as time passes and the use environment is changed, and thereby the concrete body needs repair and reinforcement. So, new materials and new construction methods for restraining the progress of the deterioration in structure and repairing and reinforcing the concrete body have been studied and developed.

Recently, as generally used methods for repairing and reinforcing the

concrete body, there are a carbon fiber sheet reinforcing method, a glass fiber sheet reinforcing method, an aramide fiber sheet reinforcing method, a steel plate adhering and reinforcing method, a method for reinforcing synthetic resin panel, in which reinforce fiber and thermosetting resin are composed, and so on. Additionally, as the concrete body repairing method, there are a patching method and a section restoring method.

The carbon fiber sheet reinforcing method, the glass fiber sheet reinforcing method and the aramide fiber sheet reinforcing method are performed in such a manner that a concrete body to be reinforced is surface-treated, primer is coated on the surface, the surface is leveled by epoxy putty agent, and the fiber sheet (carbon fiber sheet, glass fiber sheet or aramide fiber sheet) is impregnated in the concrete body and adhered to the concrete body by epoxy resin (for adhesion and impregnation).

Such reinforcing method using the fiber sheet is lightweight, and has good operation efficiency, anticorrosion, high strength, high elasticity coefficient, salt tolerance and chemical resistance. However, the reinforcing method using the fiber sheet has several problems that it is very weak in heatproof and fireproof, and thereby poisonous gas is generated and the reinforcing effect drops rapidly to cause loss of lives and properties when there is a fire. Moreover, the main process of the reinforcing method using the reinforced fiber is the impregnation of the reinforced fiber, but in fact, it is difficult to perfectly impregnate the reinforced fiber due to a difficult condition in a construction site, and the reinforcing effect and realization of performance depend on the manpower's technical level in the construction site. Furthermore, it is necessary to perform a repetitive lamination process to secure a proper reinforcing strength.

The steel plate adhering method is a construction method performed in such a manner that a concrete body to be reinforced is surface-treated, steel plates are mounted and sealed after an anchoring work and a welding work, and epoxy

resin is injected and adhered. The steel plate adhering method has several advantages that materials can be easily bought and properties of the materials can be surely shown. However, the method has several disadvantages that it is difficult to carry and handle the materials and to supervise safety because the steel plates are heavy (generally, steel plate of 4.5mm or more is used to secure required strength), and there is a danger of fire due to the use of fire for welding or others. Additionally, the method has a load burden of the reinforced concrete body due to an increase of excessive dead load after the reinforcement, corrosion of the steel plates, and weak thermal efficiency in fireproof and heatproof.

In the synthetic resin panel adhering and reinforcing method and the steel plate adhering and reinforcing method, panels are fixed with anchors, and gaps formed between the panels and a concrete body are filled with filler such as thermosetting resin. For the filling process, various materials besides the anchors are mounted, that is, spacers are mounted at regular intervals to form gap uniformly, injection holes are formed to inject the filler and air discharge holes are formed to discharge the inside air to the outside while the filler is inserted. Because the spacers, the injection holes and the air discharge holes must be mounted at several portions of the panel, it takes much time to mount them, and thereby the panel may be damaged and polluted and the filler does not sealably fill the gaps to cause a drop of the reinforcing effect because it is very difficult, in installation structure, to discharge the inside air of the anchor hole. Furthermore, because most of the existing anchors are made of metal, if the wet concrete body is reinforced, it becomes rusty as time passes, and thereby its performance is deteriorated and the outward appearance becomes bad.

The patching and section restoring methods are performed in such a manner that weak parts of the concrete body is dug and removed, an anticorrosive treatment is performed if reinforced steels are oxidized, repairing materials are inserted into cracked portions to prevent the reinforced steels from being

contacted with air or water, the removed portions are plastered with epoxy mortar, non-contracted concrete and various polymer cement mortar several times, and the section is restored. For the repairing materials and methods, various kinds of materials and methods have been developed, for example, a polyurethane injection method, an epoxy injection method for moistening, a micro-cement injection method, a section restoring method using epoxy group mortar, a section restoring method using various polymer cement mortars such as acryl group high intensity mortar, and so on. However, though the applied materials are very good, because the section restoration of the removed concrete body is finished by the plastering work, the conventional methods has a limitation in adhesive strength between the existing concrete body and the surface restored in section. Additionally, as time passes, the exfoliation and cracks are generated again and air and water flow into the exfoliated and cracked surface, and thereby the concrete body is returned into the previous condition (e.g., the reinforced steels are corroded).

Therefore, this inventor has developed a panel for repairing and reinforcing a concrete body, a multi-purpose anchor, an anchor for level adjustment and injection and a method for repairing and reinforcing the concrete body using the same to improve the conventional method for repairing and reinforcing the concrete body.

Disclosure of Invention

Accordingly, it is an object of the present invention to provide a composite reinforced panel, in which a reinforced fiber sheet is composed to a steel plate, and a method for repairing and reinforcing using it capable of securing safety of a concrete body.

It is another object of the present invention to provide a composite

reinforced panel, in which a reinforced fiber sheet is composed to a steel plate, and a method for repairing and reinforcing using it capable of maximizing features of each material, improving heatproof and fireproof properties of the composite reinforced panel by supplementing demerits of the materials, and preventing brittle break by securing softness of the composite reinforced panel.

It is a further object of the present invention to provide a lightweight precast concrete composite reinforced panel, in which steel plates are connected to a lightweight precast concrete panel, to reinforce the capacity of the concrete body.

It is a still further object of the present invention to provide reinforcing means a lightweight precast concrete panel for reinforcing the capacity of the concrete body.

It is a still further object of the present invention to provide means capable of improving bad construction due to the conventional site impregnation by manufacturing various composite reinforced panels in factory, and providing uniform and safe reinforcing effects by lowering dependence on technical engineers of a construction site in impregnation and adhesion, which are main elements of construction quality.

It is a still further object of the present invention to provide means capable of injecting filler through an anchor without any injection hole.

It is a still further object of the present invention to provide means capable of forming regular intervals between the panel and the concrete body without mounting spacers.

It is a still further object of the present invention to provide means capable of discharging air, which is between the panel and the concrete body, by the anchor without any air discharge hole while the filler is injected.

It is a still further object of the present invention to provide a lightweight precast concrete panel 410 for improving fireproof and heatproof of the surface of the concrete body, which is reinforced and finished through a reinforcing method

using the existing carbon fiber sheet, glass fiber sheet or aramide fiber sheet.

Brief Description of the Drawings

Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawing in which:

FIG. 1 illustrates a sectional view of a detailed example of a composite panel for reinforcing a concrete body according to the present invention;

FIG. 2 illustrates a flow chart showing a manufacturing method of the composite panel of FIG. 1;

FIG. 3 illustrates a sectional view of another detailed example of a composite panel for reinforcing a concrete body according to the present invention;

FIG. 4 illustrates a flow chart showing a manufacturing method of the composite panel of FIG. 3;

FIG. 5 illustrates a schematic view of a manufacturing process and a structure of a lightweight precast concrete panel according to the present invention;

FIG. 6 illustrates a flow chart of the manufacturing process of the lightweight precast concrete panel according to the present invention;

FIG. 7 illustrates a schematic view of a manufacturing process of a lightweight precast concrete composite reinforced panel according to the present invention;

FIG. 8 illustrates a brief perspective view of the lightweight precast concrete composite reinforced panel for repairing a concrete body according to the present invention;

FIG. 9 illustrates an elevation view and a sectional view of an anchor for

adjusting level of panel and injecting;

FIG. 10 illustrates a view showing a state that the anchor for adjusting level of panel and injecting is connected with an injection pipe and a clip.

FIG. 11 illustrates an elevation view and a partially sectional view of an insert and an expansion hole according to the present invention;

FIG. 12 illustrates an elevation view and a partially sectional view of a bolt and an injection pipe according to the present invention;

FIG. 13 illustrates a schematic view showing a state that a lower portion of a beam is reinforced using the lightweight precast concrete composite reinforced panel;

FIG. 14 illustrates a schematic view showing a state that a lower portion and a side of a beam is reinforced using the lightweight precast concrete composite reinforced panel;

FIG. 15 illustrates a schematic view showing a state that a damaged part of the concrete road is repaired using the panel for repairing the concrete body and the anchor for level adjustment and injection;

FIG. 16 illustrates a flow chart of an adhesion type reinforcing method, which is a method for reinforcing the concrete body using the composite panel for reinforcing the concrete body according to the present invention; and

FIG. 17 illustrates a schematic view showing a state that the damaged part of the concrete road is repaired using the panel for repairing the concrete body and a multi-purpose anchor.

Best Mode for Carrying Out the Invention

The present invention will now be described in detail in connection with preferred embodiments with reference to the accompanying drawings. For reference, like reference characters designate corresponding parts throughout

several views.

FIG. 1 illustrates a sectional view of a detailed example of a composite panel for reinforcing a concrete body according to the present invention, and FIG. 2 illustrates a flow chart showing a manufacturing method of the composite panel of FIG. 1. In FIGS. 1 and 2, the composite panel for reinforcing the concrete body includes: a steel plate 510 of a prescribed size; an impregnable adhesion layer 520' formed on an upper surface of the steel plate 510; a reinforced fiber 530 mounted on the upper surface of the steel plate 510 and impregnated and adhered by the impregnable adhesion layer 520'; and powder 540 sprayed on the upper surface of the steel plate 510 and impregnated and adhered on the surface of the impregnable adhesion layer 520'. Additionally, the manufacturing method of the composite panel includes the steps of: forming the impregnable adhesion layer 520' on a surface of the steel plate 510 cut in a prescribed size; impregnating and adhering the reinforced fiber 530 on the surface of the steel plate 510, on which the impregnable adhesion layer 520' is formed; spraying, impregnating and adhering the powder 540 on the surface of the steel plate 510 and the reinforced fiber sheet layer 530; and hardening the impregnable adhesion layer 520' formed in the second step.

In the same way as the manufacturing method, as shown in FIG. 1b, a sandwich type composite panel is manufactured in such a manner that reinforced fibers are impregnated and adhered to both surfaces of a steel plate and then powder is sprayed and adhered.

The composite reinforced panel for reinforcing the concrete body further includes: an adhesion layer formed on a lower surface of the steel plate of the composite panel (see FIGS. 1a and 1b); and a lightweight precast concrete panel 550 of a prescribed size adhered on the lower surface of the steel plate by the adhesion layer, thereby increasing reinforcing power and fireproof property. Instead of the lightweight precast concrete panel 550, another precast concrete

panel using a general aggregate may be used (see FIG. 5).

When the lightweight precast concrete panel 550 is cut in the form of a flat rectangle, the composite panel for reinforcing the concrete body of FIGS. 1a and 1b is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel. It is to increase reinforcing effect by connecting the adjacent composite panels through the composite panel of FIGS. 1a and 1b. It will be appreciated that another precast concrete panel using a general aggregate may be used instead of the lightweight precast concrete panel 550.

The composite panel for reinforcing the concrete body may include: a reinforced fiber of a prescribed size; an impregnable adhesion layer formed on an upper surface of the reinforced fiber; a steel plate mounted on the upper surface of the reinforced fiber and impregnated and adhered by the impregnable adhesion layer; and powder sprayed, impregnated and adhered on the upper surface of the steel plate. Additionally, the composite reinforced panel for reinforcing the concrete body further includes: an adhesion layer formed on a lower surface of the reinforced fiber of the composite panel for reinforcing the concrete body; and a lightweight precast concrete panel of a prescribed size mounted on the lower surface of the reinforced fiber and adhered by the adhesion layer, thereby increasing reinforcing power and fireproof property. Furthermore, when the lightweight precast concrete panel is cut in the form of a flat rectangle, the composite panel (including: a reinforced fiber of a prescribed size; an impregnable adhesion layer formed on an upper surface of the reinforced fiber; a steel plate mounted on the upper surface of the reinforced fiber and impregnated and adhered by the impregnable adhesion layer; and powder sprayed, impregnated

and adhered on the upper surface of the steel plate) is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel. It is to increase reinforcing effect by connecting the adjacent composite panels through the composite panel of FIGS. 1a and 1b. It will be appreciated that another precast concrete panel using a general aggregate may be used instead of the lightweight precast concrete panel 550.

The composite panel for reinforcing the concrete body may include: an upper steel plate of a prescribed size; a lower steel plate of a prescribed size; an impregnable adhesion layer formed on an upper surface of the upper steel plate; a reinforced fiber mounted on the upper surface of the upper steel plate and impregnated and adhered by the impregnable adhesion layer; an adhesion layer formed on an upper surface of the reinforced fiber; a lower steel plate adhered by the adhesion layer formed on the upper surface of the reinforced fiber; an adhesion layer formed on the surfaces of the upper and lower steel plates; and powder sprayed and adhered on the adhesion layer formed on the surfaces of the upper and lower steel plates. Additionally, the composite reinforced panel for reinforcing the concrete body further includes: an adhesion layer formed on a lower surface of the lower steel plate; and a lightweight precast concrete panel of a prescribed size adhered on the lower steel plate by the adhesion layer, thereby increasing reinforcing power and fireproof property. Furthermore, when the lightweight precast concrete panel is cut in the form of a flat rectangle, the composite panel (including: an upper steel plate; a lower steel plate; an impregnable adhesion layer formed on an upper surface of the upper steel plate; a reinforced fiber mounted on the upper surface of the upper steel plate and

impregnated and adhered by the impregnable adhesion layer; an adhesion layer formed on an upper surface of the reinforced fiber; a lower steel plate adhered by the adhesion layer formed on the upper surface of the reinforced fiber; an adhesion layer formed on the surfaces of the upper and lower steel plates; and powder sprayed and adhered on the adhesion layer formed on the surfaces of the upper and lower steel plates) is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel. It is to increase reinforcing effect by connecting the adjacent composite panels through the composite panel of FIGS. 1a and 1b. It will be appreciated that another precast concrete panel using a general aggregate may be used instead of the lightweight precast concrete panel 550.

The composite panel for reinforcing the concrete body may include: a steel plate of a prescribed size; an impregnable adhesion layer formed on an upper surface of the steel plate; an upper reinforced fiber mounted on the upper surface of the steel plate and impregnated and adhered by the impregnable adhesion layer; powder sprayed, impregnated and adhered on an upper surface of the upper reinforced fiber; an impregnable adhesion layer formed on a lower surface of the steel plate; a lower reinforced fiber mounted on the lower surface of the steel plate and impregnated and adhered by the impregnable adhesion layer; and powder sprayed, impregnated and adhered on a lower surface of the lower reinforced fiber. Additionally, the composite reinforced panel for reinforcing the concrete body further includes: an adhesion layer formed on a lower surface of the lower reinforced fiber; and a lightweight precast concrete panel mounted on the lower portion of the lower reinforced fiber and adhered by the adhesion layer, thereby

increasing reinforcing power and fireproof property. Furthermore, when the lightweight precast concrete panel is cut in the form of a flat rectangle, the composite panel (including: a steel plate; an impregnable adhesion layer formed on an upper surface of the steel plate; an upper reinforced fiber mounted on the upper surface of the steel plate and impregnated and adhered by the impregnable adhesion layer; powder sprayed, impregnated and adhered on an upper surface of the upper reinforced fiber; an impregnable adhesion layer formed on a lower surface of the steel plate; a lower reinforced fiber mounted on the lower surface of the steel plate and impregnated and adhered by the impregnable adhesion layer; and powder sprayed, impregnated and adhered on a lower surface of the lower reinforced fiber) is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel. It is to increase reinforcing effect by connecting the adjacent composite panels through the composite panel of FIGS. 1a and 1b. It will be appreciated that another precast concrete panel using a general aggregate may be used instead of the lightweight precast concrete panel 550.

The steel plate 510 is one of steel plates, which has good flexural strength and is generally used in steel plate reinforcing methods, and can be adjusted in thickness according to intensity of the concrete body to be reinforced. That is, because the steel plate 510 is reinforced with the reinforced fiber 530, which has excellent tension strength and elasticity coefficient, laminated steel plates of 1mm or less can be used. Furthermore, in case that an anchor fixing, injecting and adhering type reinforcing method is applied in consideration of a construction method (adhering type or anchor fixing, injecting and adhering type) of the composite panel, the steel plate 510 may have a plurality of anchor holes 511.

The impregnable adhesion layer 520' is formed by coating impregnable adhesive on the upper surface of the steel plate. For the impregnable adhesive, resin for the exclusive use of impregnation and adhesion, such as epoxy resin for impregnation and adhesion, which has good adhesive force to the steel plate and good strength and in which the reinforced fiber is easily impregnated, is proper. The impregnable adhesion layer 520 serves to coat the surface of the steel plate 510 to prevent corrosion of the steel plate 510 and improve acid-proof property.

The reinforced fiber 530 is mounted on the upper surface of the steel plate 510 and impregnated and adhered by the impregnable adhesion layer 520' to reinforce the steel plate 510. The reinforced fiber is made by selecting and composing at least one or more of carbon fiber, glass fiber and aramide fiber, which have high tension strength, good elasticity coefficient and durability. Furthermore, it will be appreciated that the reinforced fiber 530 can be laminated into several layers according to required strength of the concrete body to be reinforced. When the reinforced fiber 530 is stacked into several layers, the steps of forming the impregnable adhesion layer 520' and impregnating and adhering the reinforced fiber 530 are repeated while a worker pays attention to remove bubbles for perfect impregnation. The steel plate 510 serves to reinforce against bending or shearing, and the reinforced fiber 530 serves to reinforce tension of the steel plate to correspond to high tension force, and thereby the concrete body to be reinforced can be completely reinforced against the bending, shearing and tension and prevent brittle break of the concrete body due to lack of softness, which is one of main disadvantages of the conventional reinforcing method using the reinforced fiber. Therefore, the composite panel according to the present invention can secure safety sufficiently.

The powder 540 is sprayed, impregnated and adhered on the surface of the impregnable adhesion layer 520' before the impregnable adhesion layer 520' is hardened. The powder 540 increases the adhesive force with the adhesion resin

by making the surface of the composite panel rough, thereby helping the composite panel to be integrated with the concrete body.

FIG. 3 illustrates a sectional view of another detailed example of a composite panel for reinforcing a concrete body according to the present invention, and FIG. 4 illustrates a flow chart showing a manufacturing method of the composite panel of FIG. 3. In FIGS. 3 and 4, a precast concrete panel is applied to increase a fireproof property of the composite panel 560. The composite panel includes: a precast concrete panel 550 of a prescribed size; an adhesion layer 520 formed on an upper surface of the precast concrete panel 550; a steel plate 510 mounted on the upper surface of the precast concrete panel 550 and adhered by the adhesion layer 520; an adhesion layer 520 formed on an upper surface of the steel plate 510; and powder 540 sprayed on the upper surface of the steel plate 510 and adhered by the adhesion layer 520.

The steel plate 510 is the same as the first example, and the adhesion layer 520 is to adhere the steel plate 510 and the precast concrete panel 550 to each other. The steel plate 510 is formed by coating epoxy resin for adhesion. The precast concrete panel 550 serves to reinforce by being adhered with the steel plate 510 by the adhesion layer 520, and forms a finish surface when finished composite panel 562 is applied as a panel for reinforcing the concrete body. Because the precast concrete panel 550 is made of the same material as the concrete body to be reinforced and forms a surface cover of the steel plate 510, it is still better in fireproof than the panel, which consists of the steel plate and the reinforced fiber, and has a good finishing effect. Because the lightweight and fireproofing properties are important factors of the reinforcing panel, it is more effective to use the lightweight precast concrete panel 550.

FIG. 5 illustrates a schematic view of a manufacturing process and a structure of the precast concrete panel 110 formed by impregnating a lightweight concrete layer 111, an inorganic element group fiber sheet layer and a water

soluble cement group or polymer group resin layer.

The lightweight concrete layer 111 is poured after made by mixing cement, inorganic group porous lightweight aggregate and water using an electrical hand mixer or a mortar mixer.

The inorganic porous lightweight aggregate is mixed with cement to be used as the aggregate and lightweight. According to conditions applied to the panel, the mixed rate of the cement and the inorganic porous lightweight aggregate can be changed. In case that the inorganic porous lightweight aggregate is perlite, the mixed rate of the cement to the inorganic porous lightweight aggregate is within the range of 5% ~ 80% by weight and the panel can be adjusted within the range of the mixed rate in consideration of the required strength and heatproof property of the panel. The panel generally has proper fireproof property and strength within the mixed rate of about 20%.

The inorganic group fiber sheet layer 112 is a reinforced inorganic group fiber mesh (it is made in such a manner that inorganic group fiber is impregnated into thermosetting synthetic resin and silica sands or blast furnace steel slag are scattered evenly and then hardened), and located within the lightweight concrete layer 111. The inorganic group fiber sheet layer 112 serves to reinforce tension force of the lightweight concrete panel 110 and can form one layer or several layers. However, in the inorganic group fiber sheet layer 112, if the inorganic group fiber sheet alone is contained in the panel 110, an upper layer and a lower layer of the panel 110 are exfoliated and separated from the inorganic group fiber sheet layer 112. Therefore, if the reinforce inorganic group fiber sheet is mounted, the exfoliation and separation can be prevented. The micro-cement serves to reinforce the inorganic fiber sheet. However, because the micro-cement drops adiabatic effect of the panel, fine powder of the inorganic group porous lightweight aggregate is impregnated to reinforce the adiabatic effect of the panel. When the micro-cement and the inorganic group fiber sheet

impregnated in the inorganic group porous lightweight aggregate are impregnated into the concrete panel, water soluble cement group, polymer cement group or polymer group resin is a basal plate.

The panel 110 made through the above process goes through a natural cure and a forced cure (steam cure) in order, and then the lightweight precast concrete panel 110 is finished.

FIG. 6 illustrates a flow chart of a manufacturing process of another lightweight precast concrete panel 410 having reinforced glass fiber mesh stacked between the lightweight concrete layers 411.

The lightweight precast concrete panel 410 is finished in such a manner that lightweight aggregate, such as bony coal, and Portland cement are sufficiently mixed according to a proper mixing rate, predetermined amount of water is added, lightweight concrete sufficiently mixed by the mortar mixer is first poured to 1/3 of the thickness of the panel, a reinforced glass fiber mesh is mounted on the surface of the first poured lightweight concrete layer 411, and instantly, the lightweight concrete is second poured and cured (natural cure and steam cure). At this time, the reinforced glass fiber mesh is manufactured in such a manner that a glass fiber mesh 412 for reinforcement is impregnated into synthetic resin and silica sands or blast furnace steel slag are scattered evenly and hardened. The glass fiber mesh 412 is in the form of a net having wider intervals between fibers than general fiber sheet, and reinforces bending and tension force of the lightweight concrete. The silica sand or blast furnace steel slag 430 serves to improve adhesive force between the reinforced glass fiber mesh 412 and the lightweight concrete 411. Therefore, the lightweight precast concrete panel 410 according to the present invention has completely integrated components, and thereby the glass fiber mesh 412 is stably fixed inside the lightweight concrete to maximize tension force and improve durability of the panel. Moreover, to manufacture a thicker panel, it is preferable to stack wire meshes or reinforced

steel bars inside the lightweight concrete 411. The lightweight fireproof precast panel 410 can be utilized to make a composite reinforced panel by composing the lightweight precast panel 410 and other materials (the existing reinforced fiber (carbon fiber, glass fiber, aramide fiber, and so on) impregnating panel, prestressed reinforced fiber composite panel manufactured using a prestress method) like a reinforced fiber for impregnation, which will be described later, to show the fireproof property. Furthermore, The lightweight fireproof precast panel 410 can be utilized when it is needed to improve fireproof efficiency of the concrete body, which is reinforced through the reinforcing method using the existing carbon fiber sheet, glass fiber sheet or aramide fiber sheet or when it is needed to reinforce due to gradually reduced reinforcing effect. Additionally, the lightweight precast panel 410 can be utilized as a method for protecting and repairing surface of the concrete body by providing beautiful appearance to the concrete body, which has bad outward appearance due to material difference between the concrete body and the fiber sheet or due to aging of the concrete body.

There is a method for repairing and reinforcing the concrete body using the lightweight fireproof precast panel 410. The method is to cut the lightweight fireproof precast panel in a proper size (in the same size as or larger than the conventional tile) and compress and adhere it to the surface of the concrete body, which is reinforced through the reinforcing method using the existing carbon fiber sheet, glass fiber sheet or aramide fiber sheet, or to the surface of the severely aged concrete body with synthetic resin group adhesive or polymer cement for adhesion.

The method will be described in more detail hereinafter.

Dust and foreign matters attached on the existing basal plane are completely removed through a high pressure washer or a dust collector while the worker pays attention not to damage the reinforced fiber attached on the basal plane, and then, the worker checks flaws of portions where the existing reinforced

fiber is adhered, such as bubble, poor adhesion and exfoliation, and performs the reinforcing work. If the portions where the existing reinforced fiber is adhered are finish-coated with epoxy group or aqueous and oil group, very low viscosity epoxy group adhesive is coated, and at the same time, powder such as silica sand is sprayed on the coated surface to make the surface rough. If the portions where the existing reinforced fiber is adhered are finish-coated with urethane group, urethane group adhesive is coated.

After that, the panel is adhered, and from this step, the adhering method using synthetic resin group adhesive and the adhering method using polymer cement group adhesive are performed differently from each other. The adhering method using synthetic resin group adhesive is finished by adhering the panel and filling up joints. The epoxy or urethane group adhesive of high viscosity being in the form of grease is coated and adhered on the surface of the surface of the concrete body, on which the coated adhesive is completely hardened, and the surface of the lightweight precast panel in thickness of about 3 ~ 5mm evenly. After that, the worker makes joints within 30minutes after adhering the panel and sprays aggregate such as silica sands into the joints to make the surface rough, and then performs pointed joint work. At this time, the epoxy resin for adhesion can be used by mixing fine aggregate or fine lightweight aggregate. Material for filling up the joints is synthetic resin or the existing compound cement mortar, and a width of the joint is about 5mm. If the width of the joint is over 5mm, the worker fills up the joint twice while pressing sufficiently to prevent cracks.

The adhering method using the polymer cement group adhesive is finished by plastering mortar on the basal plane, adhering the panel and filling up the joints. When the worker plasters the mortar on the surface of the concrete body, on which the coated adhesive is completely hardened to make the surface rough, the worker performs the plastering work while paying attention not to exceed 10mm at once when the plastered thickness exceeds 10mm. After the mortar

plastering work is finished, the plastered surface is cured for a week. The worker checks and repairs excitation and cracks of the mortar plastered surface before adhering the panel. In case of an exterior construction, the worker sprays water on the surface of the panel and completely contacts the panel to the surface of the concrete body to prevent permeation of rain or water, to increase adhesive force and prevent exfoliation, freeze and fusion. A once plastered area of the basal mortar plastered surface is less than $1.0m^2$. The panel is adhered after adhesive mortar is plastered in thickness of about 3 ~ 6mm evenly. After the adhesive mortar is plastered again in thickness of about 3 ~ 4mm evenly, instantly tiles are adhered, and at this time, the worker strikes the tiles with a wood hammer to make the mortar protrude over 1/2 of the thickness of the panel at the joint portions. After the lapse of 3 hours after the adhesion of the panel, the worker digs the joints and performs the plaster joint work. Before the plaster joint work, the worker sprays water on the basal plane of the joints to maintain moisture. Preferably, the width of the joint is about 5mm, but, if the width of the joint is over 5mm, the worker fills up the joint twice while pressing sufficiently to prevent cracks.

FIG. 7 illustrates a state that the reinforced fiber sheet 120 as reinforcing means for the concrete body is connected to the lightweight precast concrete panel 110. In other words, the reinforcing means includes: the reinforced fiber sheet 120 and powder layer. The reinforced fiber sheet is impregnated based on thermosetting resin coated on the surface of the lightweight precast concrete panel 110 and thermosetting resin 123, and cut in the same size as the lightweight precast concrete panel 110 and jointed to the lightweight precast concrete panel 110, or cut larger than the lightweight precast concrete panel 110 and jointed to the lightweight precast concrete panel 110 to protrude. The powder layer is sprayed on an upper portion of the reinforced fiber sheet layer impregnated to increase the adhesion force to the concrete body to be reinforced. The

thermosetting resin 123 may be one of epoxy resin or converted epoxy resin. The reinforced fiber sheet layer is formed on the upper surface of the lightweight precast concrete panel while stacked in at least one or more layers. That is, after the impregnable adhesive is coated on the upper surface of the panel, the reinforced fiber sheet layer is finished by impregnating and adhering the reinforced fiber sheet on an upper surface of the impregnable adhesive in one layer or several layers. The reinforced fiber sheet is made by selecting and composing at least one or more of carbon fiber, glass fiber and aramide fiber, which have high tension strength, good elasticity coefficient and durability. Furthermore, to stack the reinforced fiber sheet in at least one or more layers, the steps of coating the impregnable adhesive and impregnating and adhering the reinforced fiber sheet are repeated while the worker pays attention to remove bubbles for perfect impregnation.

The composite reinforced panel consisting of the lightweight precast concrete panel, the reinforced fiber sheet layer and the powder is adhered on the concrete body by an adhering method using anchors. For this, the composite reinforced panel has a plurality of anchor holes. In case that the reinforced fiber sheet layers are stacked in several layers, the reinforced fiber sheets are cut to have different extension lengths from each other. Preferably, the extension lengths of the stacked reinforced fiber sheets are gradually shortened upward. The powder is sprayed and adhered on the surface of the reinforced fiber sheet layer before the reinforced fiber sheet layer is completely hardened. The powder makes the surface of the composite reinforced panel rough, thereby increasing adhesive force with adhesive resin during construction to help the composite reinforced panel to be integrated with the concrete body. The powder may be silica sand or blast furnace steel slag. In case that the reinforced fiber sheet layers are stacked into several layers, the reinforced fiber sheets 120 must be stacked in the same weaving direction to maximize the tension force. For means

for reinforcing capacity of the concrete body, thermosetting resin mortar may be coated instead of primer, thermosetting resin and the reinforced fiber sheet. The composite reinforced panel consisting of the lightweight precast concrete panel, the reinforced fiber sheet layer and the powder is adhered on the concrete body by an adhering method using anchors. For this, the composite reinforced panel has a plurality of anchor holes.

FIG. 8 illustrates a schematic and perspective view of a lightweight precast concrete composite reinforced panel 310 for repairing the concrete body, the panel including a lightweight concrete layer 311 and reinforcing means 312 for reinforcing the lightweight concrete layer 311. The lightweight precast concrete composite reinforced panel 310 differs from the lightweight precast concrete composite reinforced panel 110 of FIG. 5 in the reinforcing means 120.

First, the lightweight precast concrete composite reinforced panel 310 including the reinforcing means 312 connected at a side of the lightweight concrete layer 311 is made in such a manner that epoxy resin for high strength mortar and hardening agent are mixed with each other, the mixture is mixed with silica sand aggregate in a prescribed rate, and the mixture is poured on the lightweight concrete layer 311 cured by forced steam.

The lightweight precast concrete composite reinforced panel 310 having the lightweight concrete layer 311 containing the reinforcing means 312 therein can divide the lightweight concrete layer into an upper lightweight concrete layer and a lower lightweight concrete layer, and the reinforcing means 312 forms boundary parts between the upper lightweight concrete layer and the lower lightweight concrete layer. Moreover, the lightweight precast concrete composite reinforced panel 310 can be formed in two types: one being that the lightweight concrete layer 311 is formed in a previously poured and cured panel type and connected with the reinforcing means 312; and the other being that the reinforcing means 312 is impregnated before the lightweight concrete layer 311 is

hardened after being poured, and then, concrete is poured again to connect the reinforcing means 312 with the lightweight concrete layer 311. The lightweight concrete layer 311 may be replaced with the generally used high strength concrete layer if necessary.

As described above, the lightweight precast concrete composite reinforced panel 310 according to the present invention can be sorted by the reinforcing means 312. The reinforcing means 312 is selected from one of prepreg one-way carbon fiber, extra thin two-way woven carbon fiber, aramide fiber, glass fiber, a wire net, a wire mesh and a steel bar, and connected between the upper and lower lightweight concrete layers 311 by impregnated by means of epoxy resin and hardening agent. The manufacturing process will be described in more detail.

According to the width and the depth of a damaged portion 383 of the concrete body, a frame is manufactured and a special film is attached on the surface of the frame. One of Portland cement, back cement and color cement, lightweight aggregate, such as perlite, filite, celite, ALC aggregate and ALC crusher run aggregate, and water are mixed, and the mixture is poured and hardened on the frame to make a panel form, and thereby the upper and lower lightweight concrete layers 311 are formed. Epoxy resin for impregnation and hardening agent are mixed in a prescribed mixing rate and the mixture is coated on a side of the lower lightweight concrete layer thin. After the epoxy resin is coated, one of the prepreg one-way carbon fiber, extra thin two-way woven carbon fiber, aramide fiber and glass fiber is impregnated into the epoxy resin. Bubbles generated during the impregnation are removed, and epoxy resin for upper impregnation is coated again. After the epoxy resin for the upper impregnation is coated, the upper lightweight concrete layer is connected, and thereby the lightweight precast concrete composite reinforced panel 310 is formed. Alternatively, the lightweight precast concrete composite reinforced panel 310 can be formed by impregnating one of the glass fiber mesh, wire mesh and steel bar in

a condition that the lightweight concrete layer 311 is not hardened, and instantly pouring the upper lightweight concrete layer. Furthermore, a general concrete panel may be formed and used by using a general stone aggregate instead of lightweight aggregate of the lightweight concrete layer. Moreover, it is possible that the lightweight precast composite panel or the precast concrete composite panel is manufactured larger than a portion of the concrete body to be repaired and the lightweight precast composite panel or the precast concrete composite panel is cut corresponding to the portion to be repaired with a hand cutter.

Because the lightweight precast concrete composite reinforced panel 310 is light and easy in construction but uses lightweight aggregate, it has a limit in its strength. If the portion of the concrete body 380 to be repaired requires prescribed compression strength, a precast concrete composite reinforced panel 314 can be applied. The precast concrete composite reinforced panel 314 includes the reinforcing means 312 formed and connected between the upper and lower concrete layers 315 and the upper and lower concrete layers 315. As described above, the concrete layer 315 is formed by mixing generally used aggregate, cement and water, and the cement is selected from one of Portland cement, back cement and color cement. The upper and lower concrete layers 315 can be connected with the reinforcing means 312 in a previously poured and hardened panel type. Alternatively, the upper and lower concrete layers 315 can be formed in such a manner that the reinforcing means 312 is impregnated before the lower concrete layer is hardened after it is poured, and the upper concrete layer is poured again. The reinforcing means 312 of the precast concrete panel, to which the previously poured and hardened upper and lower concrete layers of the panel type are connected, is formed in such a manner that one of extra thin two-way or one-way woven carbon fiber, prepreg one-way carbon fiber, glass fiber and aramide fiber is selected, epoxy resin and hardening agent, which is lower impregnating means, are coated on a side of the lower concrete layer of the

panel type, the epoxy resin and hardening agent are coated again as upper impregnating means, and the upper concrete layer of the panel type is connected before the impregnating means is hardened. If the panel reinforcing means is glass fiber mesh, wire or steel bar, the glass fiber mesh, wire or steel bar is impregnated in the lower concrete layer before the poured lower concrete layer is hardened, and then the upper concrete layer is poured. The panel reinforcing means can be formed in such a manner that one of the wire or steel bar is mounted, synthetic resin for high strength mortar and hardening agent are mixed with each other, silica sand aggregate is mixed, and the mixture is poured and connected to the concrete body. To provide stronger connection force to the glass fiber mesh, wire and steel bar, micro-cement paste is plastered and impregnated on the surface of the glass fiber mesh, wire or steel bar. To increase the strength of the precast concrete panel, the panel is forcedly cured after the lapse of prescribed time after the hardening.

FIGS. 9 and 10 illustrate an elevation view and a sectional view of an anchor for adjusting and injecting the level of the panel according to the present invention. The anchor includes a body part 320, a nut 323, a clip 330 for carrying, and a pipe 340 for injection. The body part 320 has a hollow part 325 and is in the form of a cylinder. The body part 320 includes a male screw 321 formed on an outer circumference, a through hole 324 intersecting with the hollow part 325 at an end thereof, a female screw 333 formed on an inner circumference of the hollow part 325 at the other end thereof, and an angular protrusion 322. The protrusion 322 may be in the form of a hexagon or an octagon. The male screw 321 formed on the outer circumference of the body part 320 is to engage with the nut 323. The nut 323 is a rotatable tool connected with the protrusion 322, and when the body part 320 is rotated, the nut 323 fixed to the panel 310 is moved in a vertical direction of the body part 320, thereby adjusting the level of the panel 310. The clip 330 for carrying has a cylindrical

part 331 having a female screw 333 formed on an inner circumference thereof, and the female screw 333 is engaged with the male screw 321 of the body part 320, to which the nut 323 is engaged, thereby serving as a link to help the carrying of the panel. The pipe 340 for injection is generally in the form of a straw and has a male screw 341 formed at an end thereof. The male screw 341 of the pipe 340 is screwed with the female screw formed on the inner circumference of the protrusion 322 of the body part 320. Filler is injected into an empty space of a rear surface of the panel through the pipe 340, the hollow part 325 and the through hole 324 of the body part. When the injection of the filler is finished, the pipe 340 is removed.

FIG. 11 illustrates an elevation view and a partially sectional view of an insert 210 and an expanding tool 220 of a multi-purpose anchor for connecting the panel to the concrete body. The insert 210 has a body part 211being generally in the form of a cylinder and a plurality of holes 212 formed in the body part 211. The holes 212 formed in the body part 211 of the insert 210 serves as injection paths of the filler injected through an injection pipe 240 and as air discharge paths for discharging air between the panel and the concrete body. The body part 211 has a female screw 213 coupled with a bolt 230 inserted into a prescribed depth from an end. At the end where the female screw 213 is started, formed is a head part 214 protruding from the body part 211 and serving as a spacer. The head part 214 allows the panel connected with the anchor of the present invention to be maintained at a prescribed interval from the concrete body. Because the interval between the panel and the concrete body is determined according to the thickness of the head part 214, the thickness of the head part 214 is changed according to the interval between the panel and the concrete body. It will be appreciated that the head part 214 may have various shapes besides the shape of FIG. 11. The other end of the insert 210 is split into several sections to be spread when the expanding tool 220 is struck with a striker.

The expanding tool 220 is inserted into the insert 210 after the insert 210 is inserted into the hole formed in the concrete body, and thereby the diameter of the insert is enlarged and the concrete body and the insert 210 are jointed. To make the above operation smooth, a hollow part 221, which has a vertical section of a trapezoidal cylinder shape and in which the injection pipe 240 is inserted, is formed.

FIG. 12 illustrates an elevation view and a sectional view of the bolt 230 and the injection pipe 240 of the present invention (multi-purpose anchor). The bolt 230 includes a body part 231 and a head part 232. The bolt 230 has a hollow part 235 vertically passing the body part 231 and the head part 232 to allow insertion of the injection pipe 240. The body part 231 has a male screw 233, which is formed on the surface thereof and engaged with the female screw 213 of the insert 210, and a plurality of holes 236 serving as injection paths of the filler and as inside air discharge paths. The hollow part 235 vertically passing the center of the head part 232 has a female screw 234, which is formed on an inner circumference and engaged with the injection pipe 240. The screwing engagement between the head part 232 and the injection pipe 240 may be substituted with other coupling means having the same capacity. The hollow part 221 of the expanding tool 220 and the hollow part 235 of the bolt 230 have the same diameter, and thereby they are extended by coupling the bolt 230 and the insert 210.

The injection pipe 240, which is generally in the form of the straw, includes a head part 241 and a body part 243. The body part 243 has a diameter to the extent that the body part 243 can be inserted into the hollow part 221 of the bolt 230 and the expanding tool 220, and has a male screw 244, which is formed on an outer circumference of an end thereof, coupled with or separated from the head part 241. The injection pipe 240 receives the filler from the head part 241. A neck part of the head part 241 is formed concavely to remove the head part 241

by striking the head part 241 with a hammer after the injection of the filler. The head part 241 has a male screw 242 formed on an outer circumference of a lower end to be coupled with the female screw 234 of the bolt 230, and a female screw formed on an inner circumference to be coupled with the male screw 244 of the body part 243 of the injection pipe.

The multi-purpose anchor can be made of metal material or thermosetting resin. If the anchor is made of thermosetting resin, the anchor is prevented from corrosion, so that the anchor has good outward appearance.

The panel 560, 562 for reinforcing the concrete body in bending, shearing and tension by composing the steel plate and reinforced fiber, or the steel pate, the reinforced fiber and the precast concrete maximizes merits of each material and supplements demerits of the materials, thereby securing softness of the panel to prevent the brittle break and stably reinforce the concrete body.

The lightweight concrete composite reinforced panel, in which the reinforcing means is connected to the lightweight concrete panel to reinforce the concrete body and improve the capacity of the concrete body, improves the fireproof property of the reinforcing means impregnated, adhered and composed at the surface of the lightweight concrete panel and provides stable reinforcing effect by effectively protecting the reinforcing means from various bad environments such as sudden weather change.

The panel according to the present invention can be effectively fixed on the concrete body. The panel allows the filler to be injected through the anchor without injection hole, has the prescribed interval formed between the panel and the concrete body, and allows the air to be discharged through the anchor without any air discharge hole while the filler between the panel and the concrete body is injected. The anchor is made of thermosetting resin, so that the anchor is prevented from corrosion.

The lightweight concrete composite reinforced panel can secure uniform

impregnation by manufactured through a nonstop manufacturing system in factory. Because the composite panel manufactured in the factory is simply assembled when being constructed in a construction site, causes dropping construction quality can be removed previously and dependence on technique of the workers in the site can be reduced, so that stable and estimated reinforcing effects can be obtained.

The lightweight precast concrete panel 410 can have improved durability to the bending and tension force of the panel by stably fixing and integrating the reinforced glass fiber mesh into the lightweight concrete. Furthermore, The present invention can have good adhesion property to the concrete body by coupling the reinforced fiber sheet for reinforcing the capacity of the concrete body to the lightweight precast concrete panel 410 and the powder is sprayed on the reinforced fiber sheet to treat the surface rough.

The lightweight concrete composite reinforced panel, in which the reinforcing means is connected to the lightweight concrete panel to reinforce the concrete body and improve the capacity of the concrete body, improves the fireproof property of the reinforcing means impregnated, adhered and composed at the surface of the lightweight concrete panel and provides stable reinforcing effect by effectively protecting the reinforcing means from various bad environments such as sudden weather change.

FIGS. 13 and 14 illustrate schematic views showing a state that a lower portion of a beam is reinforced by the lightweight precast concrete composite reinforced panel 100 and a state that a lower portion and a side of the beam are reinforced by the lightweight precast concrete composite reinforced panel 100. The reinforced fiber sheet is used as the reinforcing means for reinforcing the capacity of the concrete body. As shown in the drawings, the lightweight precast concrete composite reinforced panel 100 is changed in an arranged condition between units of the panel 100 according to the shape and area of the concrete

body to be reinforced. To overlap the adjacent panel units and the reinforced fiber sheets 120 and continuously construct, the reinforced fiber sheet 120 is cut and adhered larger than the lightweight precast concrete panel 110, and thereby the reinforced fiber sheet 120 protrudes in a prescribed length. The protruded length is adjusted in proportion to weight by unit area of the reinforced fiber sheet 120. For example, if the weight of the reinforced fiber sheet 120 is 200g, 300g and 400g per $1m^2$, the reinforced fiber sheet 120 is protruded to 20cm, 25cm and 30cm. The units of the lightweight precast concrete composite reinforced panel 100 are connected in such a manner that a side of the panel 100 from which the reinforced fiber sheet 120 protrudes and a side from which the reinforced fiber sheet 120 does not protrude are faced and connected with each other. Therefore, when the lightweight precast concrete panel 110 is cut in the form of the rectangle, the reinforced fiber sheet 120 protrudes from one of the four sides of the lightweight precast concrete panel 110, from opposite sides, from three sides except one side, or all four sides of the lightweight precast concrete panel 110.

FIG. 15 illustrates a method for installing the panel to a concrete paved road 380 containing a damaged part 383 using the anchor for adjusting the level of the panel and injecting. In more detail, the worker performs a joint indication work on the damaged road surface and cuts the indicated part with a road surface cutter. The damaged part 383 of the concrete paved road surface is inside a cutting line 381, and the cutting line, which is a straight line, is at right angles with another cutting line 381. The cut part is broken by hydraulic pressure or an electric hammer. The epoxy mortar 361 in which synthetic resin of high adhesion force and silica sands are mixed in a prescribed rate is poured into the broken basal surface 388. At this time, the worker performs a leveling work of the basal surface while forming fine holes of about 10mm between the epoxy mortar coated surface and the panel. The nut 123 of the anchor is fixed into the anchor hole 313 formed in the panel 310 with synthetic resin adhesive, the body

part 320 is screwed with the nut 323, and the clip 330 is screwed with the body part 320, and then, the panel 310 is carried and seated on the broken part. After the clip 330 is removed, as described above, the body part 320 is rotated and the level of the panel is adjusted to be consistent with the concrete road surface. Because the nut 323 is fixed, when the body part 320 is rotated, the level of the panel can be adjusted. When the level adjusting work of the panel is finished, gap between the panel and the concrete paved road is sealed, a cylinder 352 for injecting low pressure is mounted at a prescribed location of the sealed part, and the pipe 340 is mounted on the anchor. First, the fine hole of the rear surface of the panel is filled with synthetic resin group filler such as epoxy resin through the injection pipe 340. To prevent occurrence of non-filled part, the filler is second injected into the fine hole of the rear surface of the panel through a low pressure injection cylinder 352. When the injection work is finished, depressed parts such as the anchor hole 313 are finished with epoxy mortar.

FIG. 16 illustrates a flow chart of a method for reinforcing the concrete body using a composite panel 560. At this time, an adhesion type reinforcing method is applied. That is, the reinforcing method includes the steps of: preparing a basal surface 500 of the concrete body to be reinforced; forming an adhesion layers 520 on the basal surface 500 of the concrete body and a surface of the composite panel 560; and adhering the composite panel 560 on the basal surface 500 of the concrete body.

If the preparing of the basal surface 500 of the concrete body is finished, anchor holes are formed at ends of the composite panel 560 or in the composite panel 560 at regular intervals. When the anchor holes are formed, dust inside the anchor holes is removed clean and permeable adhesion layer is formed on the surface (epoxy permeable adhesive is coated). The permeable adhesion layer serves to remove fine dust of the basal surface 500, reinforce weak parts to improve the adhesive force of the composite panel 560. After the permeable

adhesion layer coated on the basal surface 500 is completely hardened, epoxy adhesive for adhering the composite panel 560 is coated thick to about 3mm or more to form the adhesion layer. The adhesion layer is formed also on a surface of the composite panel 560 and contacted and fixed on the basal surface. When the composite panel 560 is fixed on the basal surface, the worker tights it with an anchor bolt, and thereby the anchor can prevent breakdown of the composite panel.

In case that the composite panels of a prescribed size are continuously installed, for perfect adhesion of connected parts, the steel plates are extended longer than the precast concrete panel, and thereby connection parts 515 are formed. At this time, powder 540 is sprayed on a lower surface of the connection parts 515 to improve adhesive force of the connection parts. If necessary, the anchor can be installed on the connection parts.

If the thickness of the composite panel in which the steel plate and the reinforced fiber are composed is more than 3mm or the lightweight precast concrete panels are combined, the panels are constructed by a method of injecting and adhering synthetic resin.

FIG. 17 illustrates a method for repairing the concrete body having the damaged part using the lightweight precast concrete composite reinforced panel 310. The damaged part 383 of the concrete body may be various.

First, if the cause of aging, material separation, neutralization, deterioration, lock pocket and exfoliation is water leakage, the worker set damaged part, forms cutting lines 381 meeting at right angles to each other and performs a cutting work. If an exposed steel bar 384 is corroded, the worker removes rust from the corroded part using a sand grinder for removing rust, and then, coats with anticorrosive using a brush. When the removal of rust and the anticorrosion work is finished, the worker perforates the damaged part using the hammer to form a packer hole for injection. After the perforation work, dust

inside the hole is removed, a packer 363 for injection is tightened and fixed, and the worker performs an injection and filling work using a high pressure injector. When coffering levee is injected through the packer 363, the packer 363 is removed by striking it with hammer, dust on the surface is removed, and wet adhesion type high strength coffering levee 371 is plastered manually or by using a steel trowel. After the lapse of 24hours after the plastering work, the worker checks whether or not there is water leakage, forms a multi-purpose anchor hole 385 using a hammer drill and removes dust and foreign matters inside the anchor hole 385 using an air pump. The multi-purpose anchor and one of the composite panels 310 for reinforcing the concrete body are installed and the level of the panel is adjusted to remove a surface deviation between the panel and the existing concrete body. The gap between the panel and the concrete body is sealed with inorganic group sealing material. Because the multi-purpose anchor serves as the air discharge hole, the air discharge hole 342 is formed only in the gap of the upper portion of the panel. After the sealing material is hardened, wet adhesion type grout material 372 is injected from the lower multi-purpose anchor upwardly. After the lapse of about 24 hours after the first injection is finished, the second low pressure injection is performed to achieve a perfect filling up. After the lapse of about 24 hours after the second injection, the depressed part around the multi-purpose anchor hole, the portion where the air discharge hole 342 is formed, and polluted surfaces are finished.

Industrial Applicability

While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and

spirit of the present invention.

What Is Claimed Is:

1. A composite panel for reinforcing a concrete body, comprising:

a steel plate of a prescribed size;

an impregnable adhesion layer formed on an upper surface of the steel plate;

a reinforced fiber mounted on the upper surface of the steel plate and impregnated and adhered by the impregnable adhesion layer; and

powder sprayed on the upper surface of the steel plate and impregnated and adhered on the surface of the impregnable adhesion layer.

2. The composite panel according to claim 1, further comprising:

an adhesion layer formed on a lower surface of the steel plate; and

a precast concrete panel of a prescribed size adhered by the adhesion layer.

3. The composite panel according to claim 2, wherein the precast concrete panel is a lightweight precast concrete panel using lightweight aggregate.

4. The composite panel according to claim 3, wherein when the lightweight precast concrete panel is cut in the form of a flat rectangle, the composite panel for reinforcing the concrete body of claim 1 is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel.

5. The composite panel according to claim1, wherein the reinforced fiber is at least one of carbon fiber, glass fiber and aramide fiber, or is formed by stacking one of carbon fiber, glass fiber and aramide fiber, by composing at least two or more of carbon fiber, glass fiber and aramide fiber, or by composing and stacking at least two or more of carbon fiber, glass fiber and aramide fiber.

6. A composite panel for reinforcing a concrete body, comprising:

a reinforced fiber of a prescribed size;

an impregnable adhesion layer formed on an upper surface of the reinforced fiber;

a steel plate mounted on the upper surface of the reinforced fiber and adhered by the impregnable adhesion layer; and

powder sprayed, impregnated and adhered on the upper surface of the steel plate.

7. The composite panel according to claim 6, further comprising:

an adhesion layer formed on a lower surface of the reinforced fiber; and

a precast concrete panel of a prescribed size mounted on the lower surface of the reinforced fiber and adhered by the adhesion layer.

8. The composite panel according to claim 7, wherein the precast concrete panel is a lightweight precast concrete panel using lightweight aggregate.

9. The composite panel according to claim 8, wherein when the lightweight precast concrete panel is cut in the form of a flat rectangle, the composite panel for reinforcing the concrete body of claim 6 is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel.

10. A composite panel for reinforcing a concrete body, comprising:

an upper steel plate of a prescribed size;

a lower steel plate of a prescribed size;

an impregnable adhesion layer formed on an upper surface of the upper steel plate;

a reinforced fiber mounted on the upper surface of the upper steel plate and

impregnated and adhered by the impregnable adhesion layer;

an adhesion layer formed on an upper surface of the reinforced fiber;

the lower steel plate adhered by the adhesion layer formed on the upper surface of the reinforced fiber;

an adhesion layer formed on the surfaces of the upper and lower steel plates; and

powder sprayed and adhered on the adhesion layer formed on the surfaces of the upper and lower steel plates.

11. The composite panel according to claim 10, further comprising:

an adhesion layer formed on a lower surface of the lower steel plate; and

a precast concrete panel of a prescribed size adhered on the lower steel plate by the adhesion layer.

12. The composite panel according to claim 11, wherein the precast concrete panel is a lightweight precast concrete panel using lightweight aggregate.

13. The composite panel according to claim 12, wherein when the lightweight precast concrete panel is cut in the form of a flat rectangle, the composite panel for reinforcing the concrete body of claim 10 is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel.

14. A composite panel for reinforcing a concrete body, comprising:

a steel plate of a prescribed size;

an impregnable adhesion layer formed on an upper surface of the steel plate;

an upper reinforced fiber mounted on the upper surface of the steel plate and impregnated and adhered by the impregnable adhesion layer;

powder sprayed, impregnated and adhered on an upper surface of the upper

reinforced fiber;

an impregnable adhesion layer formed on a lower surface of the steel plate;

a lower reinforced fiber mounted on the lower surface of the steel plate and impregnated and adhered by the impregnable adhesion layer; and

powder sprayed, impregnated and adhered on a lower surface of the lower reinforced fiber.

15. The composite panel according to claim 14, further comprising:

an adhesion layer formed on a lower surface of the lower reinforced fiber; and

a precast concrete panel mounted on the lower portion of the lower reinforced fiber and adhered by the adhesion layer.

16. The composite panel according to claim 15, wherein the precast concrete panel is a lightweight precast concrete panel using lightweight aggregate.

17. The composite panel according to claim 16, wherein when the lightweight precast concrete panel is cut in the form of a flat rectangle, the composite panel for reinforcing the concrete body of claim 14 is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel.

18. A lightweight precast concrete composite reinforced panel used in a reinforcing construction of a concrete body, the composite panel comprising:

a lightweight precast concrete panel including a lightweight concrete layer, a reinforced glass fiber mesh of a net type mounted inside the lightweight concrete layer, and water soluble cement group, polymer cement group or polymer group resin layer contained in the lightweight concrete layer, the lightweight precast concrete panel being formed through a natural cure and a forced cure in order, the

lightweight concrete layer being formed by mixing one of perlite, filite, celite, ALC aggregate and ALC crusher run aggregate, water and cement; and

concrete body reinforcing means adhered and connected to a surface of the lightweight precast concrete panel.

19. The composite panel according to claim 18, wherein the concrete body reinforcing means includes:

thermosetting resin coated on the lightweight precast concrete panel; and

an inorganic group reinforced fiber sheet impregnated into the thermosetting resin, cut and jointed in the same size as the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and protrudingly jointed with the lightweight precast concrete panel.

20. The composite panel according to claim 19, wherein the inorganic group reinforced fiber sheet is selected from at least one or more kinds of one-way woven aramide fiber sheet, prepreg type one-way woven carbon fiber sheet, cross type woven carbon fiber and glass fiber sheet, stacked in at least one or more layers, wherein if there is direction of woven fiber of the reinforced fiber sheet, the inorganic group reinforced fiber sheets are stacked and jointed in the same direction without regard to stacked number and stacked order thereof, and wherein the inorganic group reinforced fiber sheets are impregnated and jointed into the thermosetting resin whenever the reinforced fiber sheet is stacked.

21. The composite panel according to claim 20, wherein when the lightweight precast concrete panel is cut in the form of a flat rectangle, the reinforced fiber sheet is cut in the same size as the lightweight precast concrete panel to be connected with the lightweight precast concrete panel, or cut larger than the lightweight precast concrete panel and has a protrusion at one side of four sides, two protrusions at opposite sides, three protrusions at three sides except one side, or four protrusions at all sides to be connected with the lightweight precast concrete panel.

22. A lightweight precast concrete panel for improving weatherproof and fireproof properties of a concrete body reinforced by a reinforcing method using a reinforced fiber sheet, the lightweight precast concrete panel comprising:

a lightweight concrete layer formed by mixing cement, lightweight aggregate and water; and

a reinforced glass fiber mesh stacked and integrated into the lightweight concrete layer, the reinforced glass fiber mesh being formed by impregnating a glass fiber mesh into an impregnable adhesive and spraying and hardening silica sands or blast furnace steel slag.

23. A method of installing a lightweight precast panel, the method for additionally reinforcing a concrete body reinforced by a reinforcing method using a reinforced fiber sheet to improve fireproof property or for forming a beautiful finished surface on the concrete body requiring refinish due to a bad outward appearance, the method comprising the steps of:

removing foreign matters from a surface of the concrete body;

checking error of the surface of the concrete body and supplementing the surface;

coating an adhesive or mortar on the surface of the concrete body and a surface of the lightweight precast panel of claim 22 and adhering the lightweight precast panel to the concrete body; and

digging joints between the lightweight precast panels and performing a pointed joint work.

24. A lightweight precast concrete composite reinforced panel used in a reinforcing construction of a concrete body, the composite panel comprising:

a lightweight precast concrete panel of claim 22; and

a reinforced fiber impregnated panel or a prestressed reinforced fiber composite panel adhered and stacked on an upper surface of the lightweight precast concrete panel.

25. A multi-purpose anchor comprising:

an insert of a cylindrical shape, the insert including a body part and a head part, the body part having a plurality of holes (212) formed on an outer circumference, the body part having an end having a female screw and the other end split into several sections, the head part formed at the end on which the female screw is formed protruding from the body part and having a prescribed thickness;

an expanding tool inserted into the insert and having a hollow part vertically passing therein, the expanding tool having a size and a shape capable of expanding the diameter of the insert;

a bolt having a body part, a head part extending from an end of the body part and having a diameter larger than that of the body part, and a hollow part vertically passing the center of the body part and the head part, the body part having a male screw coupled with the female screw of the insert and a plurality of holes, the hollow part being connected with the holes of the body part and having a female screw formed on an inner circumference of the head part; and

an injection pipe having a concave neck part, a head part and a body part, the head part having a male screw formed on an outer circumference and coupled with the female screw formed on an inner circumference of the bolt head part, and a female screw formed on an inner circumference thereof, the body part having a male screw formed on an outer circumference of an end thereof and coupled with the female screw formed on the inner circumference of the head part, the injection pipe being inserted into the hollow part of the bolt and the hollow part of the expanding tool when the insert and the bolt are coupled.

26. A lightweight precast concrete composite reinforced panel for repairing and reinforcing a concrete body, the composite panel comprising:

a lightweight concrete layer formed by mixing one of perlite, filite, celite, ALC aggregate and ALC crusher run aggregate, cement and water; and

panel reinforcing means connected to a surface of the previously poured and

hardened lightweight concrete layer of a panel type.

27. A precast concrete composite reinforced panel for repairing and reinforcing a concrete body, the composite panel comprising:

a lower concrete layer formed by mixing sand for concrete, aggregate, cement and water and having a compression strength equal to or stronger than the concrete body to be reinforced;

a precast concrete panel made in such a manner that one of a reinforced glass fiber mesh, a wire and a steel bar is installed inside the lower concrete layer, and instantly, the same concrete as the lower concrete layer is poured on an upper portion; and

concrete body reinforcing means connected at a surface of the precast concrete panel.

28. A precast concrete composite reinforced panel for repairing and reinforcing a concrete body, the composite panel comprising:

a lower concrete layer formed by mixing sand for concrete, aggregate, cement and water and having a compression strength equal to or stronger than the concrete body to be reinforced; and

a precast concrete panel made in such a manner that one of a reinforced glass fiber mesh, a wire and a steel bar is installed inside the lower concrete layer, and instantly, the same concrete as the lower concrete layer is poured on an upper portion;

wherein one of the reinforced glass fiber mesh, wire or steel bar is installed on a surface of the precast concrete panel, synthetic resin for high strength mortar and hardening agent are mixed, and the mixture is mixed with silica sand aggregate and poured and adhered.

29. A precast concrete panel for repairing and reinforcing a concrete body, the precast concrete panel comprising:

a lower concrete layer having compression strength equal to or stronger than

the concrete body and previously poured and hardened to be formed into a panel type;

one of extra thin two-way or one-way carbon fiber, prepreg one-way carbon fiber, glass fiber and aramide fiber impregnated on an upper surface of the lower concrete layer by means of epoxy resin and hardening agent; and

an upper concrete layer formed of the same material and in the same mixing rate as the lower concrete layer and adhered to the impregnated fiber by means of the epoxy resin and hardening agent, the upper concrete layer being previously poured and hardened to be formed into the panel type.

30. A lightweight precast concrete composite reinforced panel for repairing and reinforcing a concrete body, the composite panel comprising:

a lower lightweight concrete layer formed by mixing one of perlite, filite, celite, ALC aggregate and ALC crusher run aggregate, cement and water;

panel reinforcing means adhered on an upper surface of the lower lightweight concrete layer; and

an upper lightweight concrete layer adhered on an upper surface of the panel reinforcing means and made of the same material as the lower lightweight concrete layer.

31. The composite panel according to claim 30, wherein the panel reinforcing means impregnates and adheres one of prepreg one-way carbon fiber, extra thin one-way and two-way carbon fiber, aramide fiber and glass fiber between the previously poured and hardened upper and lower lightweight concrete layers of the panel type by means of epoxy resin and hardening agent.

32. The composite panel according to claim 30, wherein the panel reinforcing means is formed in such a manner that one of a glass fiber mesh, a wire and a steel bar is covered on the upper surface of the lower lightweight concrete layer of the panel type, silica sands, epoxy resin for high strength mortar and hardening agent are mixed, the mixture is poured on the upper surface of the lower

lightweight concrete layer to adhere the upper lightweight concrete layer of the panel type to the lower lightweight concrete layer.

33. A method for repairing and reinforcing a concrete body having damaged part due to aging, material separation, neutralization and deterioration, the method comprising the steps of:

cutting the damaged part into a rectangle;

digging and removing concrete contained inside cut lines;

forming an anchor hole;

installing the multi-purpose anchor of claim 25 and one of panels of claim 26 through claim 32 into the anchor hole;

sealing boundary parts between the panel and the broken concrete part with inorganic group sealing material or synthetic resin group sealing material;

forming a plurality of air discharge holes at an upper boundary part of the boundary parts;

injecting high strength synthetic resin by means of the multi-purpose anchor; and

finishing a surface of the panel with inorganic material.

34. An anchor for adjusting the level of a panel and injecting, the anchor comprising:

a body part of a cylindrical shape and having a hollow part formed generally, the body part having a male screw formed on an outer circumference, a through hole formed at an end thereof and intersecting with the hollow part, and an angular protrusion formed at the other end having a female screw on an inner circumference of the hollow part;

a nut screwed with the male screw of the body part;

an injection pipe of a generally straw shape, the injection pipe having a male screw formed at an end thereof and screwed with the female screw of the body part; and

a clip having a cylindrical part and a ring part connected to the cylindrical part, the cylindrical part having a female screw formed on an inner circumference and screwed with the male screw of the body part.

35. A method for repairing and reinforcing a concrete body in case that a concrete paved road has a damaged part, the method comprising the steps of:

preparing a precast concrete panel, which has a plurality of anchor holes for installing the anchor of claim 34 and on which steel bars are arranged or not arranged;

cutting the damaged part into a rectangle;

digging and removing concrete contained inside cut lines;

coating epoxy mortar on the dug and removed concrete surface;

fixing the nut of the anchor of claim 34 into the anchor hole of the precast concrete panel;

screwing the nut fixed into the anchor hole and the body part of the anchor of claim 34 and arranging the precast concrete panels on the dug concrete road surface;

rotating the body part of the anchor to adjust the level of the panel;

sealing boundary parts between the panel and the concrete road surface with sealing material;

injecting and filling synthetic resin adhesive using a straw; and

removing the straw and sealing and finishing the anchor holes of the panel with inorganic group resin.

【FIG.1】

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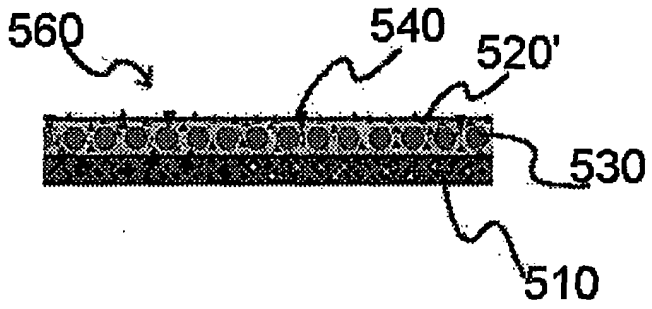

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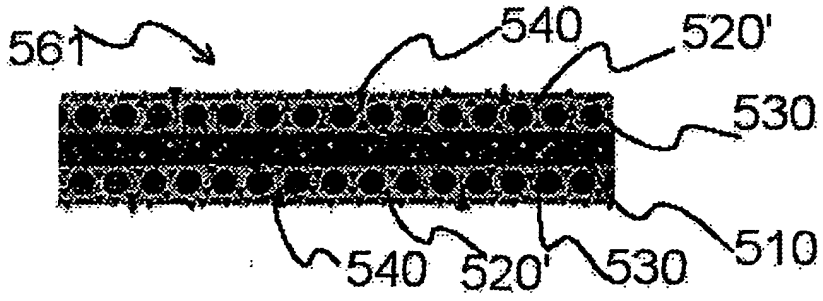
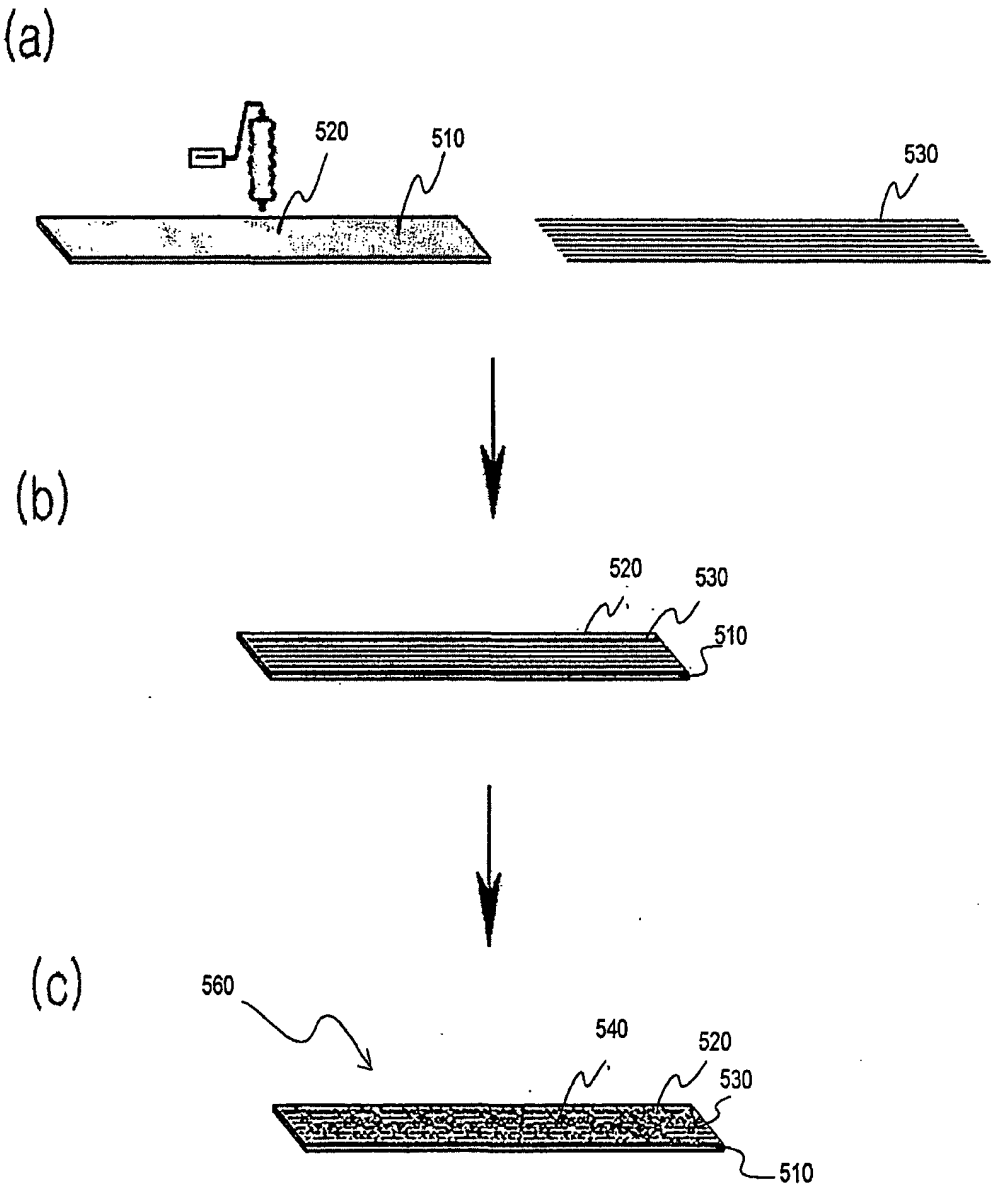
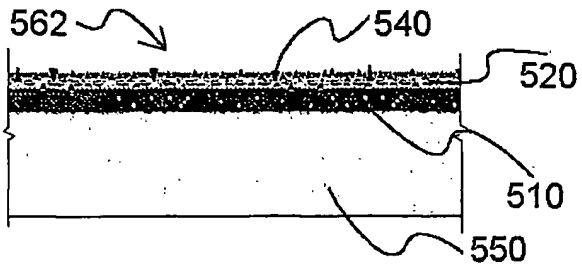


【FIG.2】



【FIG.3】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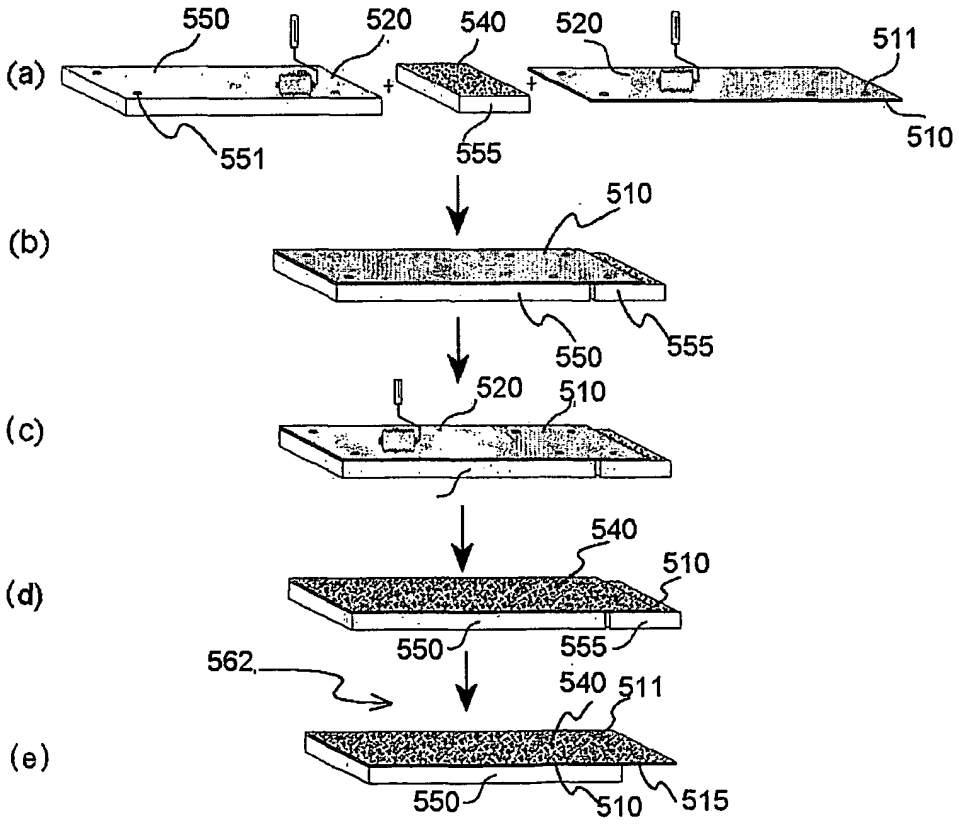
【FIG.4】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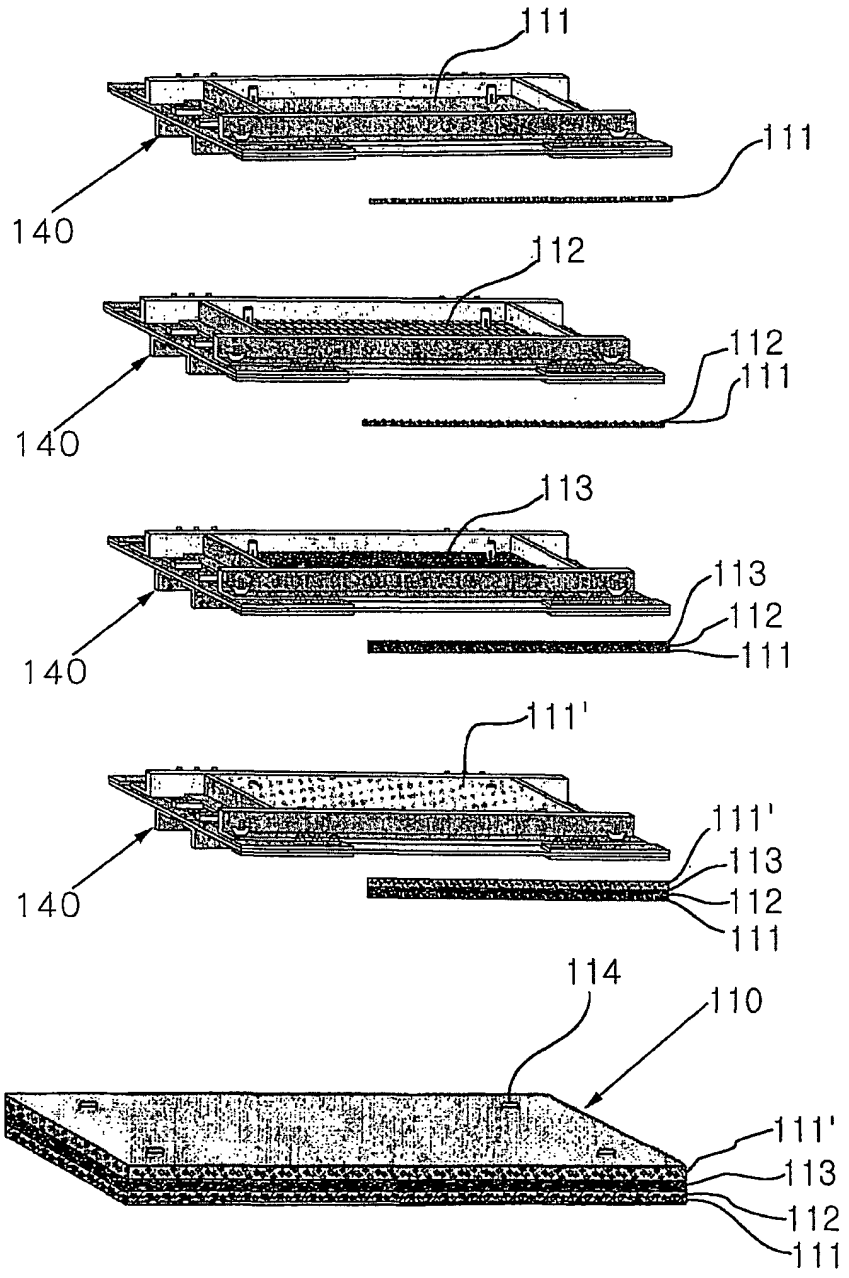
【FIG.5】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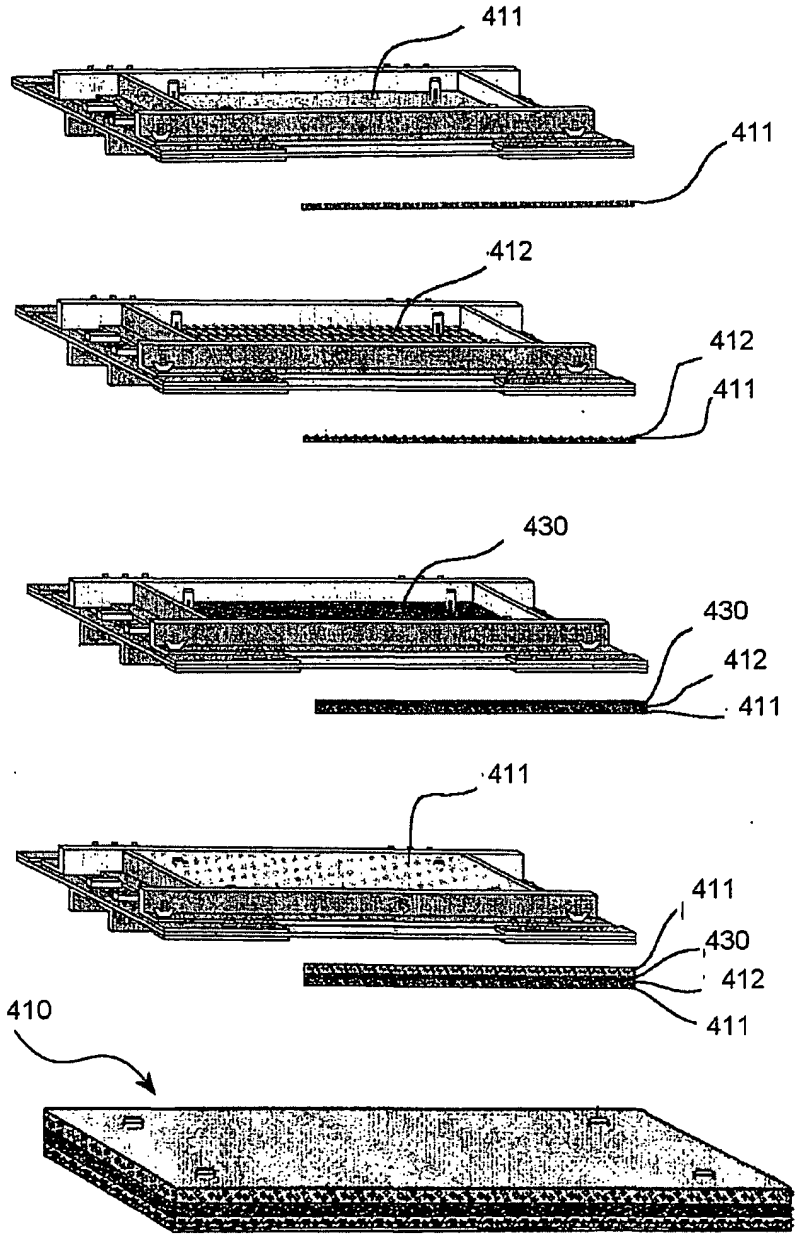
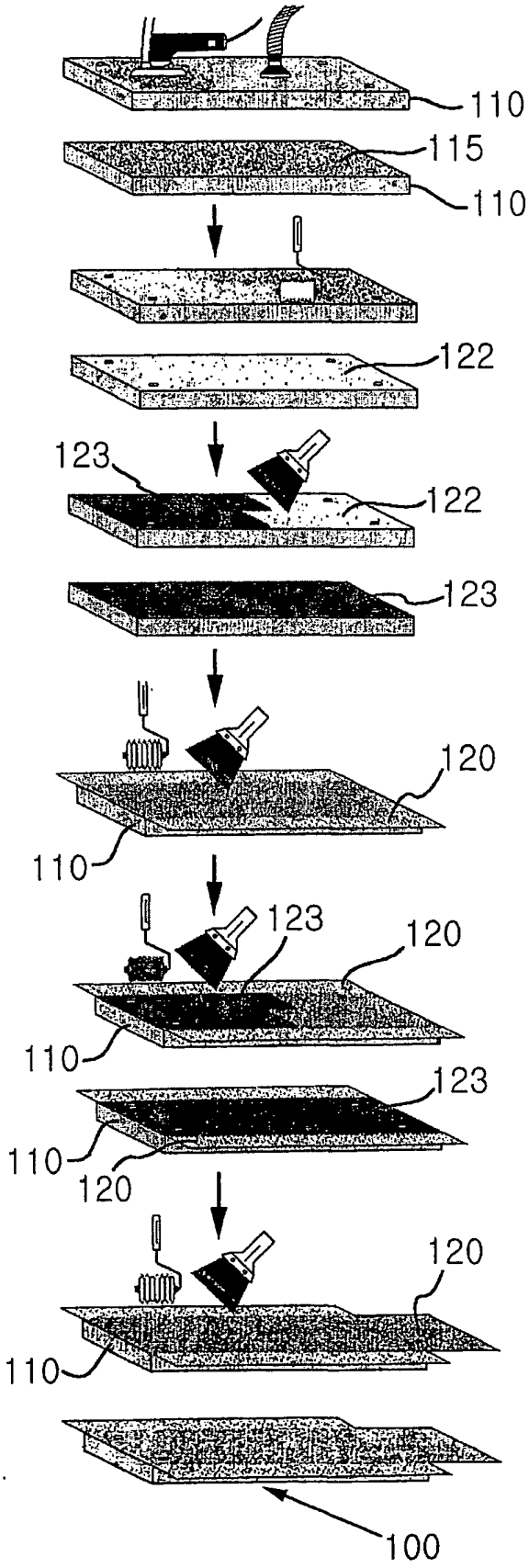
【FIG.6】



【FIG.7】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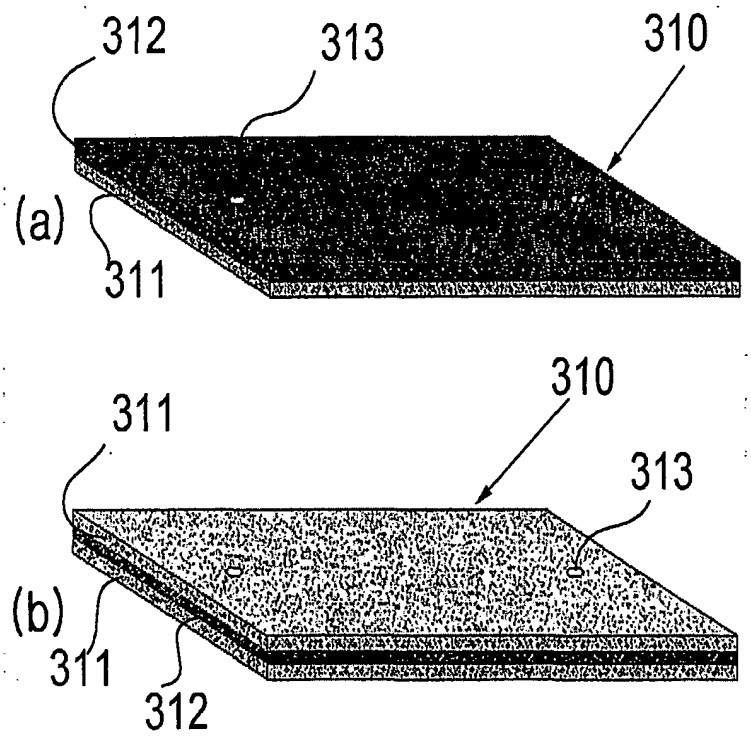
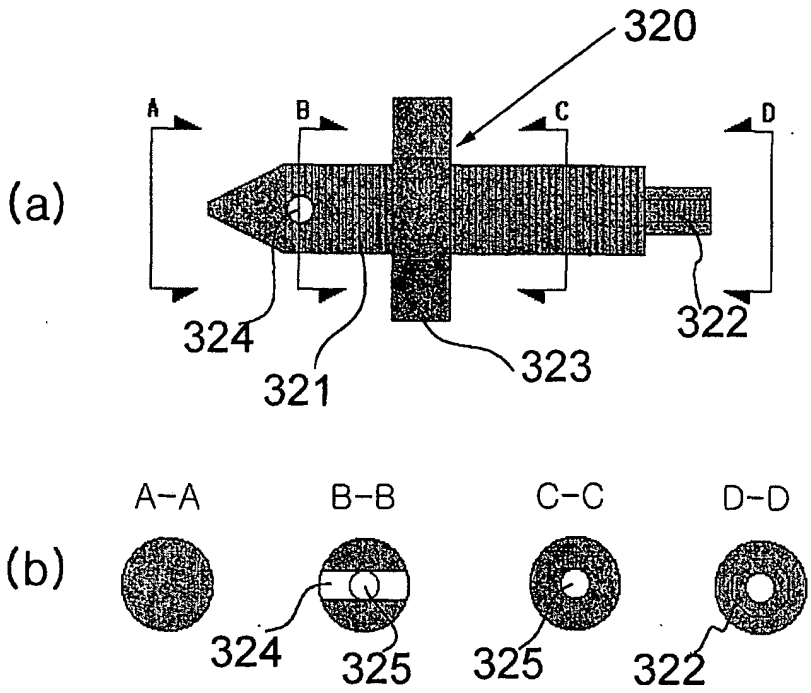
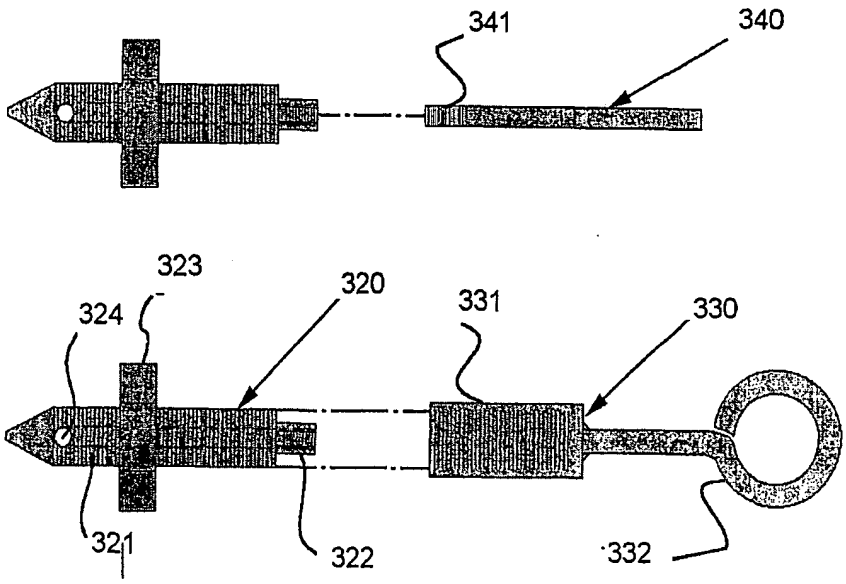
【FIG.8】



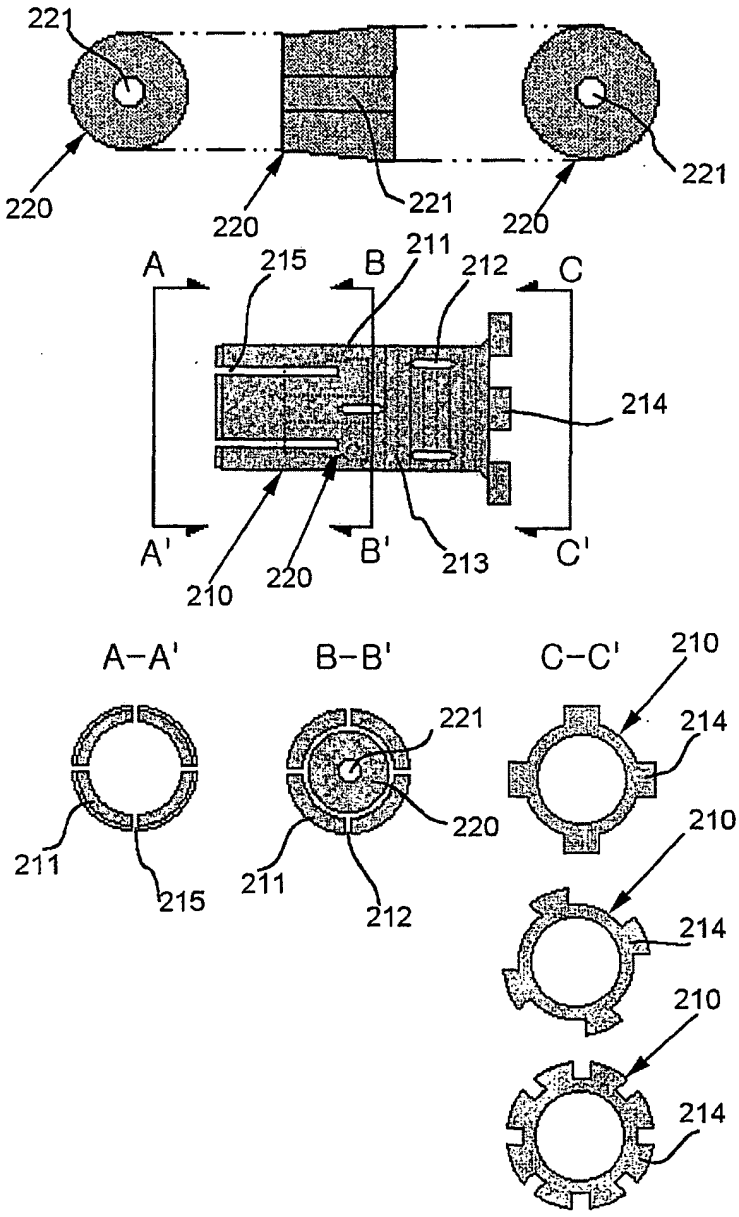
【FIG.9】



【FIG.10】



【FIG.11】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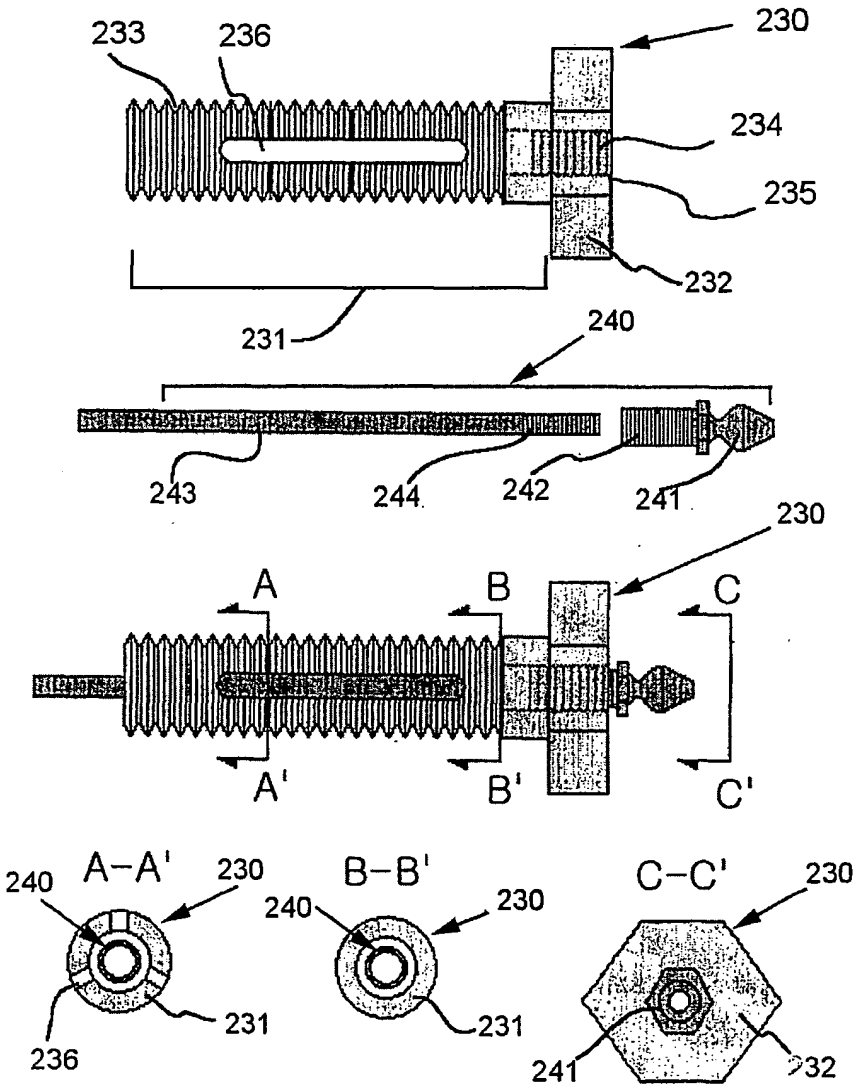
【FIG.12】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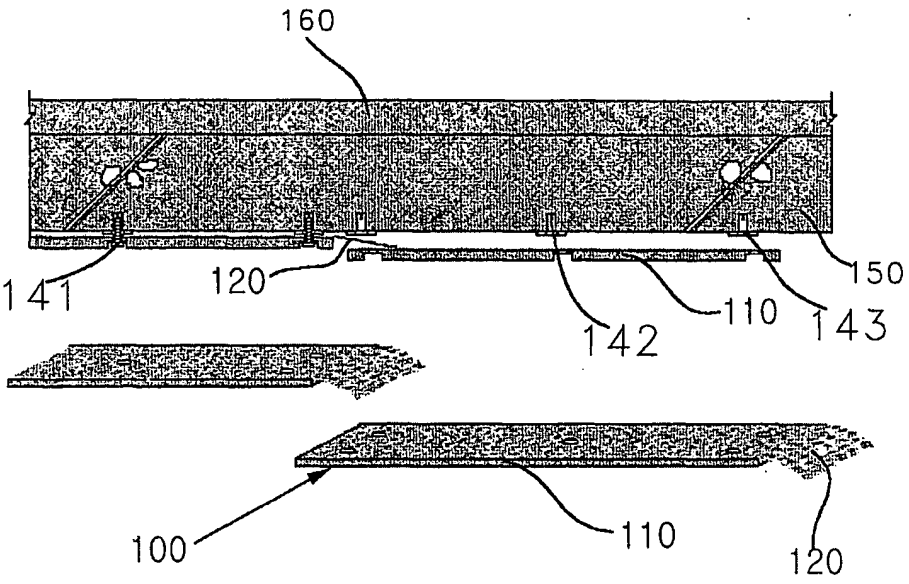
【FIG.13】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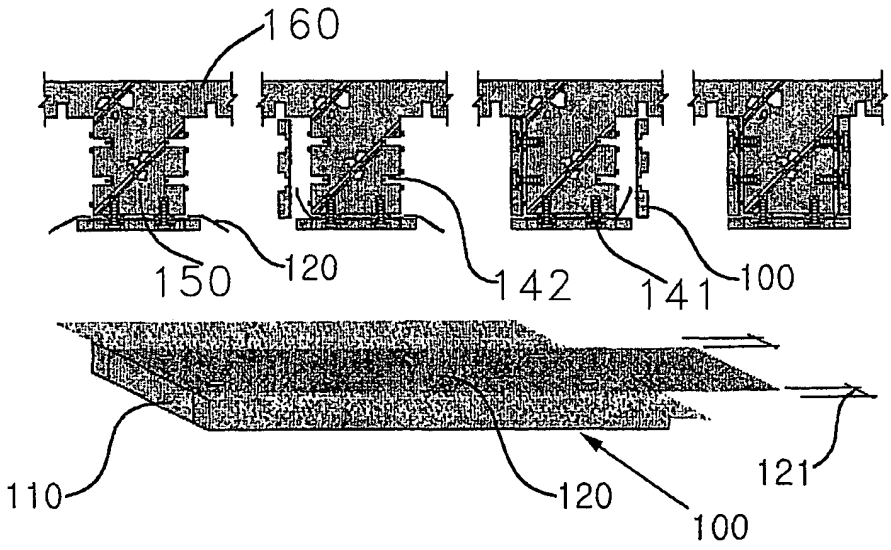
【FIG.14】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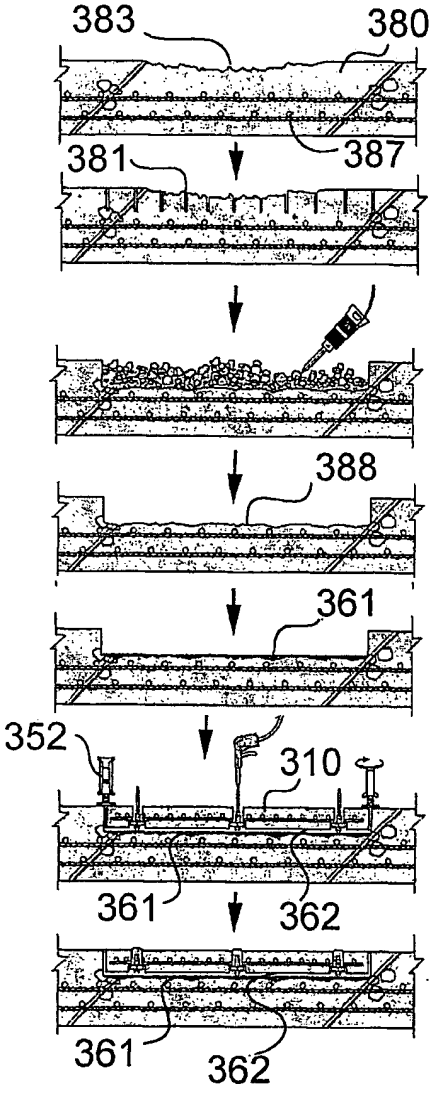
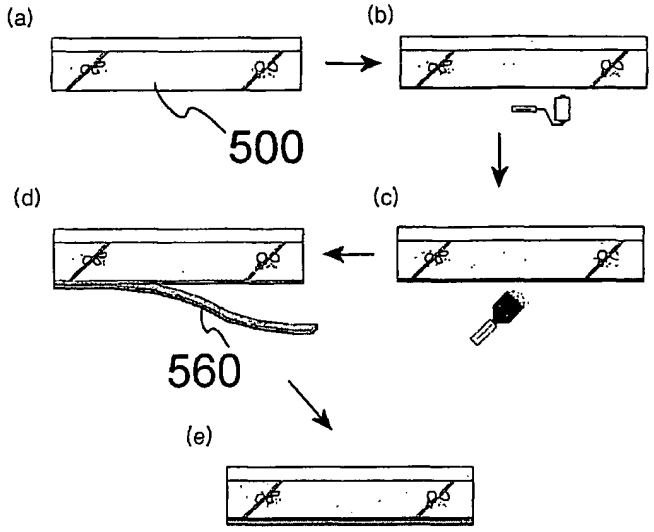
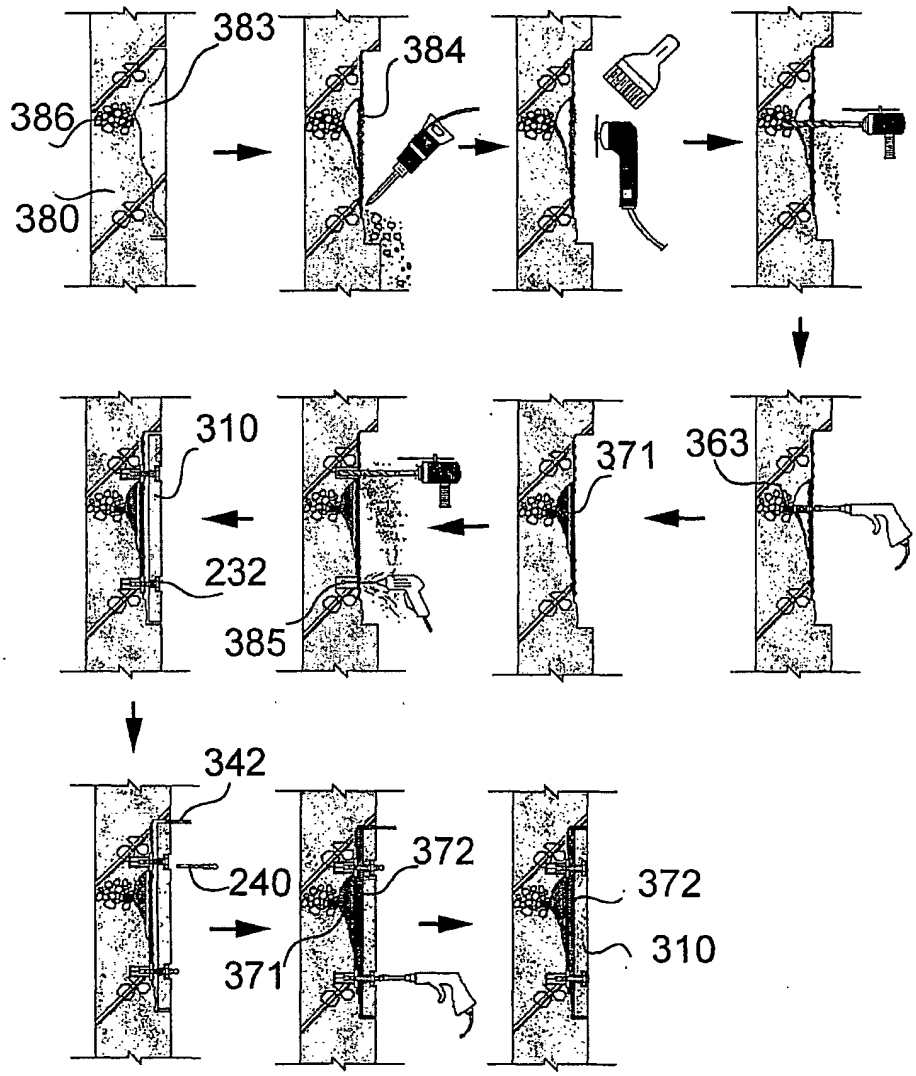
【FIG.15】



【FIG.16】



【FIG.17】



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/01830

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 E04G 23/02, E01D 22/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 E04G 23/02, E01D 22/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR, JP : classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0942118 A (LEONHARDT ANDRAE UND PARTNER B.I. VBI GmbH) 15 SEPTEMBER 1999 see the whole document	1, 5, 6, 10, 14
Y	KR 96-41577 A (LEE, OK-SIN) 19 DECEMBER 1996 see the whole document	1, 5, 6, 10, 14, 33
Y	KR 94-2455 A(LEE, YUN-JIN) 17 FEBRUARY 1994 see the whole document	1, 5, 6 , 10, 14, 33
A	KR 98-78892 A (RYOU, SEONG-KWEON) 25 NOVEMBER 1998 see the whole document	1-35
A	KR 97-65923 A (CHUNG- JO ENGINEERING CO., Ltd.) 13 OCTOBER 1997 see the whole document	1-35

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevence

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 FEBRUARY 2002 (20.02.2002)	20 FEBRUARY 2002 (20.02.2002)

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon, 920 Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea	LEE, Young Min
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5804

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/01830

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 93-8256 A (NIPPON MENTE KAIHATSU K.K.) 21 MAY 1993 see the whole document	1-35
A	US 5657595 A (HEXCEL-FYFE Co., L.L.C.) 19 AUGUST 1997 see the whole document	1-35
A	KR 1999-15976 A (SAMSUNG TRADE Co,. Ltd.) 5 MARCH 1999 see the whole document	1-35

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/01830

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 23, 26, 27
because they relate to part of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Due to the broad and indefinite scope of these claims, the International Search Authority finds that for economic reasons no meaningful search could be carried on said claims.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Search Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be established without effort justifying an additional fee, this Authority did not invite payment of any addition fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR01/01830

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0942118 A	15.09.99	DE 19810179 A1	16.09.99
KR 96-41577 A	19.12.96	None	
KR 94-2455 A	17.02.94	None	
KR 98-78892 A	25.11.98	None	
KR 97-65923 A	13.10.97	None	
KR 93-8256 A	21.05.93	JP 5-98810 A2 EP 535944 A US 5329740 A	20.04.93 07.04.93 19.07.94
US 5657595 A	19.08.97	AU 6267396 A1 EP 835355 A1 JP 200050839 T2	30.01.97 15.04.98 04.07.00
KR 99-15976 A	05.03.99	None	

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